DOCUMENT RESUME

ED 449 982 SE 064 504

AUTHOR	Schwerin, Theresa
TITLE	NASA Earth Science Enterprise 2000 Education Catalog.
INSTITUTION	National Aeronautics and Space Administration, Washington, DC. Office of Earth Science.
REPORT NO	NASA-EP-2000-02-395-HQ
PUB DATE	2000-01-00
NOTE	89p.
AVAILABLE FROM	For full text: http://earth.nasa.gov/education.
PUB TYPE	Guides - Non-Classroom (055) -- Reference Materials - Directories/Catalogs (132)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	*Earth Science; *Educational Technology; Elementary Secondary Education; Higher Education; *Informal Education; Interdisciplinary Approach; Preservice Teachers; *Science Curriculum; *Science Programs; *Space Sciences
IDENTIFIERS	*Systemic Change

ABSTRACT

The National Aeronautical Space Administration's (NASA) Earth Science Enterprise (ESE) produces a wide range of products for teachers and students and supports educational activities for all grade levels in cooperation with the NASA Headquarters Education Division. This catalog presents the diverse educational programs, products, and resources available for students, teachers, and faculty. Contents include: (1) Student Support, which includes enrichment activities and research opportunities for all educational levels; (2) Teacher/Faculty Preparation and Enhancement, which features enhancement activities and programs for preservice teachers, inservice teachers, and faculty; (3) Support for Systemic Change, which describes programs supporting the development of a systemic change; (4) Curriculum Support and Dissemination, which includes activities supporting elementary through college curriculum and focuses on the interdisciplinary approach; (5) Educational Technology, which describes advanced technologies used in science education programs; (6) Informal Education, which provides opportunities outside formal settings; (7) Earth Science Enterprise Education Products, which lists ESE products; and (8) NASA Resources for Educators. (YDS)

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National Aeronautics and Space Administration

Educational Services	
Teachers & Faculty	Grades K–University

EP-2000-02-395-HQ

EARTH SCIENCE ENTERPRISE

2000 Education Catalog

U.S. DEPARTMENT OF EDUCATION
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COVER IMAGE

TRMM Rainfall superimposed on AVHRR Pathfinder July 98 monthly average.

Image produced by the Visualization Analysis Laboratory, Laboratory for Atmospheres, Goddard Space Flight Center (see the Acknowledgements on page 80 for a description of this image).

NASA Earth Science Enterprise: 2000 Education Catalog is available on the World Wide Web at:

http://earth.nasa.gov/education

National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

Reply to Attn of

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FEB 16 2000

Dear Colleague:

Since the first US Earth-observing satellite was launched in 1959, NASA has made unique and unparalleled contributions to better understanding planet Earth. Using the unique vantage points from space, and sub-orbital platforms, the Earth Science Enterprise (ESE) is dedicated to understanding the total Earth system and the effects of natural and human-induced changes on the global environment.

This understanding is necessary to establish informed policies on long-term economic growth that creates jobs and protects the environment, and have significant practical value to society. ESE is committed to building awareness, understanding, and working knowledge of the results of ESE science, applications and technology activities. This is accomplished through formal and informal means of teaching, learning, and other forms of communication.

We are very pleased to present the *NASA Earth Science Enterprise: 2000 Education Catalog* for exploring the diverse education programs, products and resources available to you. Our programs continue to reflect the education goals of our nation and NASA, by encompassing educator training opportunities, student support activities and print/digital resources for all learners from Kindergarten through post doctorate and early career professional levels.

Our intent is to continue working with you - our partners in education and outreach - to effectively reach the largest audience possible. As you use this document, you will notice that our program has expanded over the last year to emphasize on-line educator training and resources as well as programs for under-served/underrepresented populations. The growth of online and technology-based projects and resources, as well as a new focus on informal education programs, builds on our solid foundation of successful, high-quality formal education programs.

This catalog is published and updated for the purpose of providing you with the most current information on our diverse education program and resources. In addition to this print version, we will provide additional information as it becomes available on our Web site at www.earth.nasa.gov. Please integrate these tools into your invaluable efforts to bring cutting edge Earth science research and technology into the hands and minds of our children and the broad, general public.

Sincerely,

Ghassem R. Asrar
Associate Administrator for
Earth Science

Vicki A. Novak
Associate Administrator for
Human Resources and Education

NASA
EARTH SCIENCE ENTERPRISE

2000
Education Catalog

Office of Earth Science
National Aeronautics and
Space Administration

Washington, DC
January 2000

NASA
EARTH SCIENCE ENTERPRISE

2000
EDUCATION CATALOG

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INTRODUCTION

The turn of the century marks a very exciting time for NASA's Earth Science Enterprise (ESE). A new generation of Earth science—one that studies the Earth's land, oceans, air, ice, and life as a total global system—began with the launch of Terra on December 18,1999. Terra is the "flagship" of NASA's Earth Observing System series of satellites, part of a precedent setting program designed to provide information on the health of the Planet and an understanding of its complex interactions in a manner that has scientists on the edge of their seat.

The year 2000 also marks an exciting time for NASA's Earth Science Education Program. This program has evolved into a sustainable, national education program, which promotes science, mathematics, geography, and technology literacy at all education levels. Annually, tens of thousands of teachers and students participate in NASA Earth science education activities.

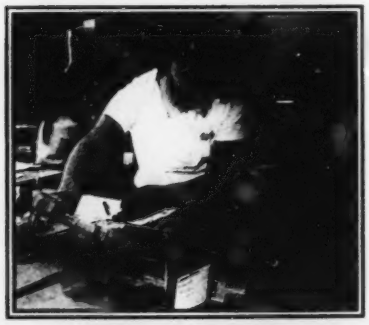
ESE supports a variety of education activities developed in partnership with the NASA Headquarters Education Division, and carried out through NASA Field Centers, universities, and other organizations. These activities are at all education levels, including:

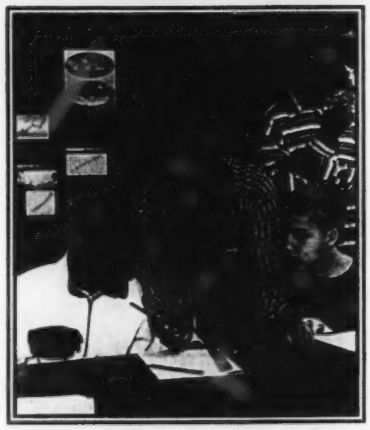
- Student support, including hands-on education experiences, research opportunities, fellowships, brief courses, and summer workshops;
- Teacher and faculty preparation and enrichment, including training workshops, courses, and research positions at NASA Centers;
- Support for systemic change, which aims to infuse Earth system science content into state curricula and education systems;
- Curriculum support, including developing education products and model curricula;
- Educational technology, using advanced technologies for education at all levels; and
- Informal education, providing opportunities outside formal school settings, where individuals of all ages, interests, and backgrounds can increase their appreciation and understanding of Earth system science [illegible] global climate change.

Using imagery and other information from its science program, ESE also produces a wide range of education products for teachers and students. CD-ROMs, Internet sites, posters, teachers' guides with classroom activities, videotapes, and slide sets all make NASA data and information available to classrooms across the country. Teachers and students are involved in the development of these products, from initial concept definition through testing and evaluation.

NASA Earth Science Enterprise: 2000 Education Catalog provides information about Agency-wide Earth science education programs and resources for elementary through university levels. An online version of this catalog, which is updated regularly, is available at:
http://earth.nasa.gov/education

STUDENT SUPPORT





Student support includes enrichment activities, such as brief courses, summer workshops, and hands-on science education experiences, which expose students to Earth system science subjects and processes. It also includes research opportunities through programs that provide direct financial assistance and fellowships, as well as research and training at NASA facilities and universities. These programs are providing opportunities for students at all education levels to develop new skills, gain experience working with researchers, and to learn first-hand about Earth system science careers and research.

ELEMENTARY & SECONDARY

Access Earth

http://www.usm.maine.edu/coe/mecats/earth/

Access Earth is a program for high school students with disabilities and teachers to encourage students with disabilities to enter careers in Earth system science. Students and teachers attend an intensive week-long summer institute focusing on land-ocean-atmosphere interactions, with field activities based at the Wells National Estuarine Research Reserve on the coast of Maine. Topics to be covered include climate change and sea level rise, land use changes, atmospheric pollution, and coastal watershed management. Participating teachers will work with scientists, educators, and students with disabilities to develop, test, and refine accessible Earth system science curriculum. Students will work with scientists, collecting and analyzing scientific data, and will learn about career opportunities in Earth system science.

The institute will typically be offered in July, but interested persons should check the Web site for further information. The program will run in the summers of 2000, 2001, and 2002, and is limited each year to ten teachers and fifteen students from Maine, New Hampshire, or Vermont. High school teachers of Earth science, general science, or environmental science are especially encouraged to apply, but applications will be accepted from other disciplines. Students should be entering ninth or tenth grade. Participating teachers are expected to further test and refine curriculum in their classrooms during the school year. Course materials and room and board are provided. Participants also receive a $500 stipend upon successful completion of the institute.

CONTACT: Nancy Lightbody, College of Education and Human Development, University of Southern Maine, 328 Bailey Hall, Gorham, ME 04038; Phone: (207) 228-8115; Fax: (207) 780-5224; Email: nancy@lightbody.org

Ames Aerospace Encounter

http://enc. .nter.arc.nasa.gov

NASA Ames Research Center hosts fourth, fifth, and six grade classes in an interactive, hands-on program, entitled the ***Ames Aerospace Encounter.*** Located in a renovated supersonic wind tunnel, the Aerospace Encounter involves students in activities focused around four topics: aeronautics, space science, living and working in space, and Earth system science.

In the Earth science section, children

work with a variety of scientific information collected by aircraft and spacecraft. The Earth system science tutorial features images of Earth taken from aircraft and satellites. The students find their way from space to Moffett Field, California by identifying specific geographic features in these remotely-sensed images. In Aeronautics, students learn about the principles of flight, wind tunnels, and use computers to design airplanes. In the Space Sciences section youngsters experience some of the basics of physics in fun physical ways. Young people become astronauts on a simulated space station with different experiments to complete.

The Ames Aerospace Encounter is free; groups are accepted on a space-available basis for this popular program.

CONTACT: Ames Aerospace Encounter, Mail Stop 226-1, NASA Ames Research Center, Moffett Field, CA 94035-1000; Phone: (650) 604-1110

Boreal Forest Watch

Boreal Forest Watch (BFW) is an educational outreach program for the Boreal Ecosystem Atmosphere Study (BOREAS). BFW involves 9–12 graders in conducting real research as part of their educational experience. Teachers and students practice the scientific method by participating in an on-going research project. They are able to integrate multidisciplinary skills in a problem-solving approach. All activities within the program meet or exceed provincial educational standards in science, mathematics, and other fields.

BFW takes place in the boreal ecosystem region of northern Saskatchewan and Manitoba, Canada. Students and teachers from several area schools near Prince Albert, SK and Thompson, MB conduct environmental monitoring studies in the boreal forests near their schools. Students set up permanent sampling plots and assess the current condition of this plot. They also collect data such as tree height, diameter, overstory and understory species composition, tree core analysis, land cover mapping and remote-sensing activities, and plant anatomical characteristics among many other measurements and activities. These data are collected and archived for future use in ecological monitoring studies of the boreal region as well as in class studies.

Teachers are trained on how to conduct program activities, which includes introduction and training in remote-sensing principles. Intensive BFW training workshops are held periodically in the Prince Albert area.

CONTACT: Shannon Spencer, Complex of Earth, Oceans, and Space, Morse Hall, University of New Hampshire, Durham, NH 03824; Phone: (603) 862-1792; Fax: (603) 862-0188; Email: shannon.spencer@unh.edu or—Bradley Muir, Prince Albert National Park, Waskesiu Lake, Saskatchewan, CANADA, S0J 2Y0; Phone: (306) 663-5322; Fax: (306) 663-5424; Email: b.muir@sk.sympatico.ca

Challenger Center for Space Science Education

http://www.challenger.org/

Challenger Center for Space Science Education is an international, not-for-profit education organization created in 1986 by the families of the astronauts tragically lost during the Challenger space shuttle mission. Using space exploration as a theme, the Center's highly acclaimed programs inspire students to pursue math, science, and technology studies, while at the same time helping them develop critical life skills.

The organization launched the Challenger Learning Center Network in 1987. Learning Centers use technology-rich educational environments to create hands-on and minds-on learning experiences. They offer a variety of programs, from mission simulations for students to professional development workshops for instructors. Each year, more than 300,000 students visit 37 Challenger Learning Center sites across the United States, Canada, and the United Kingdom. Challenger Center for Space Science Education has developed the four flight scenarios offered at Challenger Learning Centers. *Voyage to Mars, Encounter Earth, Return to the Moon,* and *Rendezvous with a Comet* allow students to rev up their imaginations and transform themselves into astronauts, scientists, and engineers. All four scenarios, which meet or exceed National Science Education Standards, were developed with NASA engineers and scientists to ensure an authentic experience.

Mission scenarios and fees vary by location. Groups of up to 38 individuals are accepted on a space-available basis. Log on to **http://www.challenger.org** for the Learning Center nearest you.

CONTACT: Challenger Center for Space Science Education, 1250 North Pitt Street, Alexandria, VA 22314; Phone: (703) 683-9740 or 1-800-98-STARS; Fax: (703) 683-7546

Chesapeake Bay Watershed Initiative

http://henry.pha.jhu.edu/msgc/cbwi.html

The Chesapeake Bay Watershed Initiative is a Mid-Atlantic Space Grant Consortia initiative involving K–12 students. Utilizing a hydrology-based scientific experiment, students determine if possible causes and effects of changes in nutrient levels in tributaries of the Bay can be correlated with weather phenomena and/or remotely-sensed changes in land cover or use. Teams of students with varying levels of expertise measure, code, and electronically report *in situ* observations of water quality, compile weather information and analyze Landsat satellite imagery to investigate nutrient changes in time and space. Code forms and observation are transportable nationwide.

CONTACT: Anne Anikis, Assistant Director, Maryland Space Grant Consortium, The Johns Hopkins University, Bloomberg Center for Physics and Astronomy, Room 203, 3400 N. Charles Street, Baltimore, MD 21218-2686; Phone: (410) 516-7106; Fax: (410) 516-4109; Email: anne@pha.jhu.edu

The Dynamic Earth

http://www.discoverycube.org

Discovery Science Center is an interactive science center with over 100 hands-on exhibits augmented by educational programming and materials providing learning opportunities for students, teachers, and family audiences. ***The Dynamic Earth*** program includes:

- Resource materials and kits provide the classroom teachers with a set of hands-on materials that will enable the students to design and test experiments. The curriculum packet contains science content information, vocabulary list, a materials list, timeline for preparation and implementation, tips for managing the students or classroom during hands-on experiences, a bibliography of additional materials, and a collection of professional contacts.
- Teacher training program in the use of these materials and lesson plans. This six-hour training, along with the teacher's guide and kit will enable two to three weeks of classroom instruction.
- An interactive science presentation for the classroom or general public.
- Family science nights at the science center. These evenings will introduce families to the science programs presented in the schools. Families will observe science demonstrations, attend science lectures, interact with the hands-on exhibitry, such as an earthquake simulation room, an eight-foot free-standing tornado, and a kalliroscope that models the fluid dynamics of the ocean and/or the atmosphere.

Some of the concepts the participants in The Dynamic Earth program will investigate are:

- Plate tectonics and the changing patterns of land, sea and mountains on the Earth's surface;
- How the Sun's heating of the Earth's surface drives convection within the atmosphere and oceans, producing winds and ocean currents, leading to an understanding of global weather patterns and geographical distribution of marine and terrestrial organisms; and
- Human impact on the Earth's atmosphere, and in turn how the altered atmospheric conditions affect all life on Earth.

Interested parties should contact the Education Department or Group Bookings at (714) 542-2823.

CONTACT: Janet Yamaguchi, Vice President, Education, Discovery Science Center, 2500 North Main Street, Santa Ana, CA 92705; Phone: (714) 542-2823; Fax: (714) 542-2828; Email: jyamaguchi@discoverycube.org

EarthKAM

http://www.earthkam.ucsd.edu/

EarthKAM enables students to explore and learn about Earth using images taken from the unique and powerful perspective of space. EarthKAM has accumulated a wealth of images, taken remotely by middle school students operating an electronic still camera flown in Earth orbit. These visible-light images show a diversity of regions and physical features, from every continent except Antarctica—all available on the educational, user-friendly, Web-based data system. Educational materials are also available online to help educators get started with the program and integrate working with images into their classrooms and curricula.

EarthKAM's main objectives are:

- To integrate Earth images with inquiry-based learning to enhance curricula in support of national and state education standards;
- To provide students and educators the opportunity to participate in a space mission and to develop teamwork, communication, and problem solving skills;
- To engage teams of students, educators, and researchers in collaborative investigations using remotely-sensed data; and
- To incorporate the active use of Web-based tools and resources in support of the learning process.

Educators for grades 5 through 12 are invited to use the EarthKAM images and materials available on the EarthKAM Web site. Middle schools also have the opportunity of applying to join the online EarthKAM Community. The community provides additional information and support for students and educators as they conduct collaborative, inquiry-based investigations based upon the images and their classroom studies. Details on the benefits of and requirements for joining the EarthKAM Community are available on the Web site.

EarthKAM is a collaboration among NASA, the University of California, San Diego, and TERC's Center for Earth and Space Science Education.

CONTACT: EarthKAM Coordinator, Center for Earth and Space Science Education, TERC, 2067 Massachusetts Ave, Cambridge, MA 02140; Phone: (617) 547-0430; Fax: (617) 349-3535; Email: EarthKAM_Coordinator@TERC.edu

Forest Watch

http://www.forestwatch.sr.unh.edu

Forest Watch is an environmental education program developed and run by Complex Systems Research Center at the University of New Hampshire (UNH). It is designed to introduce both teachers and their students to field, laboratory, and satellite data analysis methods for assessing the state-of-health of local forest

stands. Forest Watch provides workshops which are designed to help K–12 teachers introduce their students to selected hands-on techniques for evaluating the health of white pine (Pinus strobus), a bio-indicator for tropospheric ozone damage. Students and teachers setup permanent sampling plots in a forest stand and conduct several ecological and biophysical measurements using scientific protocols.

In conducting ecological site assessments, students are introduced to several disciplines of science, such as botany, biology, chemistry and physics, as well as other non-scientific disciplines. Students participate in three types of activities in Forest Watch: 1) forest stand assessment, including the selection of white pine trees for study, 2) laboratory-based assessment of foliar damage symptoms for the selected trees, and 3) image processing/data analysis of Landsat Thematic Mapper (TM) data for the area around their school. The student field and laboratory measurements are sent to the University of New Hampshire, where they are analyzed and integrated into an on-going regional white pine study.

CONTACT: Dr. Barry Rock, Program Director, or Mr. Shannon Spencer, Program Coordinator, Complex System Research Center, Morse Hall, University of New Hampshire, Durham, NH 03824; Phone: (603) 862-1792; Fax: (603) 862-0188; Email: forestwatch@unh.edu

Global Learning and Observations to Benefit the Environment (GLOBE)

http://www.globe.gov

GLOBE is a worldwide network of K–12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near their schools and report their data via the Internet. GLOBE environmental measurements are in the following study areas: Atmosphere, Hydrology, Land Cover, Soils, GPS, and Seasons. Scientists use GLOBE data in their research and provide feedback to the students to enrich their science education. Each day, images created from the GLOBE student data sets are posted on the World Wide Web, allowing students and visitors to the GLOBE Web site to visualize the student environmental observations. Teachers and students from over 6,500 schools in over 80 countries currently participate in GLOBE.

An interagency team manages GLOBE, which includes NASA, the National Oceanic and Atmospheric Administration, the National Science Foundation, the Environmental Protection Agency, and the Departments of Education and State.

There is no cost to participate in the GLOBE Program. However, schools must support participation by one or more teachers to attend a GLOBE Training Workshop and make available to students the equipment for taking measurements and Internet access for reporting their data.

CONTACT: GLOBE Program, 744 Jackson Place, Washington, DC 20503; Phone: (800) 858-9947; Email: info@globe.gov

Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)

http://icp.giss.nasa.gov

ICP's mission is to contribute an innovative model for teaching and learning science that connects NASA's climate system research to national science standards and foster the professional/academic advancement of minority students in the sciences. The ICP is conducted in collaboration with the City University of New York (CUNY), Columbia University, New York City Public Schools, and Science Systems and Applications, Inc.

Student Research Interns and Faculty Fellows are competitively selected from New York City area pre-college and college institutions and given tangible roles on GISS research teams organized to advance our understanding of climate forcings and natural variability that produce climate change. Activities during Summer Institutes (six–eight weeks) and an Academic Year Program (GISS- and school-based) are designed to facilitate research projects and develop relevant science skills and content understandings. Annually, student researchers at GISS and/or ICP schools make presentations at science fairs, regional and national science competitions and the ICP Spring and Summer Conferences. ICP students view research experiences as a means to their advancement in the science pipeline, with program alumni now entering highly competitive schools and job markets. Throughout the year, ICP faculty and GISS scientists collaborate to produce student projects and lessons, as well to share them at professional meetings and conferences.

With the support of NASA's Minority University-Space Interdisciplinary Network Resource Training Site at the City College of New York (CCNY), ICP schools are gaining the technical competencies and resources needed to participate in an electronically connected research and education network.

An Earth Climate Teacher Education Course and school-based Teacher Institutes are the newest components under development. The context for the course and institutes is to examine the Earth's climate as an evolving, dynamic system by investigating how the input solar radiation interacts with the system characteristics to produce the output climate conditions. Partnerships with Columbia University, CUNY and New York City Urban Systemic Initiative are contributing to these teacher courses and institutes.

CONTACT: Carolyn Harris, NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025;
Phone: (212) 678-5653;
Fax: (212) 678-5552;
Email: charris@giss.nasa.gov

The JASON Project

http://www.jasonproject.org/

The JASON Foundation engages students in science and technology, and motivates and provides professional development opportunities for teachers through the use of advanced interactive telecommunications. JASON expeditions, targeted for grades 4–10, are supported by extensive teacher training and award-winning curriculum and Internet program, and feature live, interactive broadcasts through robotics, fiber optics, television production, computer science, and satellite communications. JASON programs are broadcast to 36 Primary Interactive Network Sites (PINS) throughout the United States and the world. JASON also provides live broadcasts of expeditions directly to classrooms and through streaming video on the Internet. NASA PINS include Ames Research Center, Goddard Space Flight Center, and Johnson Space Center. Programs focus on oceans, rainforests, extreme environments, volcanoes and exploration of inner and outer space. All programs focus on connecting students and teachers with researchers and scientists in the field.

The JASON Project is reasonably priced by unit for individual or school-wide participation. For more information on how to get involved, visit the JASON on the Web at **http://www.jasonproject.org** or call 1-888-JASON-00.

CONTACT: JASON Foundation for Education, 395 Totten Pond Road, Waltham, MA 02451;
Phone: (781) 487-9995;
Fax: (781) 487-9999;
Email: info@jason.org

NASA Student Involvement Program (NSIP)

http://www.nsip.net

NSIP is NASA's national competition for students in grades 3–12, designed to link students directly with NASA's diverse and exciting missions of research, exploration, and discovery. Annual competitions foster student literacy in science, mathematics, engineering, technology and geography. Teachers use NSIP to support curricular goals, spark student interest, encourage creative thinking across disciplines, and involve students in science process skills. Program information and entry forms are provided in the annual NSIP *Program Announcement*, available in print and via the Internet prior to the new school year. Supplemental information is provided in Educator Resource Guides available for each of the competition categories: Design a Mission to Mars; Watching Earth Change; Earth Systems in My Neighborhood; Aeronautics and Space Science Journalism; and Flight Opportunities.

Entries are judged at NASA Centers, students may receive judges' comments about their entry. All qualified entrants receive NASA certificates of participation. Prizes include NASA presentations at schools; trips to the National Symposium, Student Flight Week, and Space Camp; and student experiments launched on a NASA Sounding Rocket or the Space Shuttle. Beginning in 2000, the Institute for Global Environmental Strategies (IGES) will award the $4,000 Thacher Scholarship to a first-place, high-school Center Winner in the Watching Earth Change competition.

CONTACT: Obtain complete information at **http://www.nsip.net** or by calling 1-800-848-8429.

Project SUN—Students Understanding Nature

http://sunshine.jpl.nasa.gov

NASA's Genesis Mission currently sponsors ***Project SUN*** as part of its outreach effort to instill knowledge in students about the natural links between the Earth and Sun. It is also carried out in partnership with the Astronomy and Physics Department and the College of Extended Learning, California State University, Northridge (CSUN). Project SUN is a component of the CSUN International Science Network (ISN).

Through Project SUN, secondary students all over the world are contributing to the long term, time resolved, monitoring of both visible and UV radiation on the Earth's surface. Data is usually transmitted to NASA's Jet Propulsion Laboratory (JPL) via the Internet. Participating schools purchase their own equipment, total cost about $600, not including the cost of a computer supplied by the school to use for the data logger. Schools agree to supply NASA JPL at least two days of data per week for a full school year. The equipment can be used the other three days for individual research projects such as investigation of the efficiency of different items of solar energy equipment, use of UV skin blockers, effects of enhanced UV radiation on plants, etc. It is hoped each school will integrate Project SUN as a continuing program, using the concept of a school research team, just as the school has established athletic teams.

The components of Project SUN are: 1) low cost, scientifically accurate instrumentation; 2) computer interfacing coupled with old computers such as the Apple IIE, Apple IIC, Macintosh and old IBM compatibles used as dedicated data loggers; 3) appropriate software and curriculum; and 4) a detailed operating strategy and a system of in-service teacher training. Part of this training is via the CSUN course Physics 595s, Solar Flux Detection, which is taught over the Internet by Dr. Gilbert Yanow.

Very careful, annual re-calibration of the commercial instruments and a continuing program of instrumentation quality control done in cooperation with the manufacturers, maintains the accuracy of the data.

CONTACT: Gilbert Yanow, NASA Jet Propulsion Laboratory, Mail Stop 264-370, 4800 Oak Grove Dr., Pasadena, CA 91109; Phone (818) 354-8060; Fax (818) 393-1392; Email: gilbert.yanow@jpl.nasa.gov

Students' Cloud Observations Online (S'COOL) Project

http://asd-www.larc.nasa.gov/SCOOL/

S'COOL is a component of the Clouds and the Earth's Radiant Energy System (CERES) project of NASA's Earth Science Enterprise. The first CERES instrument was launched in late 1997 to provide global data on clouds. The 2nd and 3rd instruments were launched on the Terra spacecraft in December 1999. S'COOL Project participants make ground truth measurements for the CERES experiment. Ground truth measurements are land-based observations to compare with satellite data for the purpose of improving the satellite results.

Participating classes are asked to make basic weather observations and to record the type and features of clouds in the sky at the time that the satellite passes over their location. Observations are then either entered in an online form, emailed, faxed or mailed to NASA for entry into an online database. Students have access to their results as well as those from other participating schools. Satellite observations for matching times will also be captured so that CERES scientists can evaluate the results and students can compare their observations to the satellite's.

Selected participants will receive some instructional materials, satellite overpass times, and information necessary for reporting results. There is no cost to participate.

CONTACT: Those interested in participating should send email to scool@larc.nasa.gov or write to: Attn: S'COOL, Mail Stop 420, NASA Langley Research Center, Hampton, VA 23681-2199 USA. The following information is requested: name of teacher; name of school and grade/age level (minimum of 3rd grade is suggested); postal and email (if available) address; whether or not the class has Internet access; location (city, state and country, as well as latitude and longitude, if known)

Student's Online Atmospheric Research (SOLAR): A SAGE III Educational Outreach Program

http://arbs8.larc.nasa.gov/sage3/

The Stratospheric Aerosol and Gas Experiment III (SAGE III) will play a critical role in NASA's Earth Science Enterprise by monitoring the distribution of aerosols and trace gases in the upper atmosphere, from Earth orbit. The long-term data provided by SAGE III will enable atmospheric scientists to assess possible influences of human activities and natural events and the Earth climate system and other atmospheric processes such as ozone depletion. SAGE III is planned for launch in late 1999. Two additional SAGE III sensors are planned for launch within the next several years, one of which will be placed on the International Space Station. This combination of SAGE III instruments should provide critical measurements well into the next century.

The SAGE III outreach program has selected a project that will help students in grades 9–12 develop hands-on skills in working with scientific equipment. It will also give students experience in collecting, analyzing, and reporting scientific data. The project involves collecting atmospheric data using a small hand-held instrument, a sun photometer. Students can build a sun photometer from inexpensive parts available at Radio Shack. This small hand-held device measures intensity of direct sun light, and can be used to determine attenuation of sun light caused by aerosols and gases in the Earth's atmosphere. The sun photometer is a simplified version of the satellite-based SAGE III instrument, and the measurement concept is basically the same as that of SAGE III.

CONTACTS: David C. Woods, Mail Stop 475, NASA Langley Research Center, Hampton, VA 23681-0001; Phone: (757) 864-2672; Fax: (757) 864-2671; Email: d.c.woods@larc.nasa.gov

Susan C. Walters, Mail Stop 475, NASA Langley Research Center, Hampton, VA; Phone: (757) 864-5879; Fax: (757) 864-2671; Email: s.c.walters@larc.nasa.gov

Visiting Student Enrichment Program

The Visiting Student Enrichment Program (VSEP) offers students summer employment with the Universities Space Research Association (USRA), working with NASA Goddard Space Flight Center's (GSFC) scientists. Student projects have included simulating a neural network, preparing image analysis algorithms on supercomputers, developing computational science applications, and creating interactive World Wide Web sites.

Project experiences are available each summer for a ten-week period, (high school students may start/stop one .wo weeks later) at GSFC in Greenbelt, MD. The first, the individual research experience, matches one student with a staff member as a mentor to work on a project. The second, the group research experience, places up to six students in a team that will work on a project under the supervision of a staff member. Both paths provide opportunities to work with scien-

tists and professionals at a world-class facility while offering a meaningful work experience primarily focused on computer science or the application of computers to solve problems in other sciences. VSEP will also offer field trips and lectures to broaden appreciation for the GSFC mission and activities.

The Program is open to full-time students in computer science, the physical sciences, and mathematics. All students will be evaluated relative to their school-level peers. Participants must be either U.S. citizens or foreign nationals in U.S. schools who possess a work visa. An annual announcement solicits application materials, which are typically due in January.

CONTACT: Visiting Student Enrichment Program, USRA, Mail Code 930, NASA/Goddard Space Flight Center, Greenbelt, MD 20771; Phone: (301) 286-4403; Email: VSEP@cesdis.usra.edu

You Be the Scientist with Satellite Imagery in EZ/EC Communities

http://nia.ecsu.edu/nrts/ess/earth.html

You Be the Scientist with Satellite Imagery in EZ/EC Communities is a student enrichment project for six targeted middle schools located in the economic empowerment zone communities of Portsmouth, Virginia and Halifax, North Carolina. The student enrichment component is designed to support extracurricular science activities structured to maximize awareness of and utilization of GOES satellite data to meet core Earth Science learning objectives and to develop marketable skills in the area of computer technology. The You Be The Scientist program launches students into the 21th century with organized integrated science and technology educational enrichment activities.

The program also includes a component that exposes students to a variety of careers available in research, data analysis, applications, and computer visualization. NASA educational sites, which provide a wealth of resources on science careers and Earth system science concepts, are integrated into the career component.

Implementing this project is Elizabeth City State University (ECSU), at which the Minority University-Space Interdisciplinary Network (MU-SPIN) Office of Goddard Space Flight Center has established a Network Resources and Training Site (NRTS). ECSU brings satellite imagery to middle schools in its region in an effort to enhance the study of mathematics and science by underrepresented minority students. The program is designed to aggressively strengthen the current Earth System Science (ESS) outreach to EZ/EC middle schools by GSFC and the ECSU-NRTS.

CONTACT: Dr. Linda Bailey Hayden, NASA Network Resources and Training Site, Elizabeth City State University, Box 672, 1704 Weeksville Road, Elizabeth City, NC 27909; Phone: (252) 335-3696; Fax: (252) 335-3790; Email: lhayden@umfort.cs.ecsu.edu

UNDERGRADUATE

Aurora

The Department of Physics at Hampton University and NASA Langley Research Center (LaRC) will sponsor ***AURORA,*** an intensive six-week undergraduate summer program, which will be held June 13–July 23, 2000. The goals of the program are to provide exceptional undergraduates with quality research experiences in atmospheric sciences and to encourage them to pursue graduate studies and careers in science. The participants will conduct cutting edge research in atmospheric science under the guidance of world-class research scientists at Hampton University and NASA LaRC. Participants will be awarded room and board on the campus of Hampton University, a $2,000 stipend and a travel allowance.

In order to apply, students must have a minimum 3.0 grade point average, and submit an application, three letters of recommendation from professors or scientists and an official university transcript. The applications will be available and distributed to universities by the middle of December 1999. The deadline for receipt of application packages is April 15, 2000. Awards will be announced at the beginning of May 2000.

CONTACT: Barbara Hall Maggi, AURORA Outreach Director, Center for Atmospheric Sciences (CAS), Hampton University; Phone: (757) 727-5869 or (757) 727-5108; Email: bmaggi@infi.net and cas@hamptonu.edu.

Biosphere 2

http://www.bio2.edu/

Columbia University's ***Biosphere 2*** Center is a unique facility—a three-acre, enclosed, ecological laboratory for studying the future of planet Earth. The million gallon ocean allows for intensive marine research, the terrestrial areas focus on trace gas studies and challenges of the future in a high CO_2 environment. This internship program offers undergraduates the chance to do research inside the Biosphere 2 facility, as well as at near-by field sites in the Sonoran Desert and Gulf of California. The Center is located on a beautiful 250-acre ecological site (4,000) foot elevation and will provide students the opportunity to work a broad spectrum of research problems in and outside the Biosphere 2 facility. It is adjacent to Tucson, Arizona and near Mt. Lemmon, the nation's southernmost ski resort at 9000 ft. Mt. Lemmon ascends numerous life zones into oak forest, ponderosa pines and finally the Canadian zone with its Douglas firs and fern gardens. It is also two hours from Mexico

and four hours from the Sea of Cortez, which complements the Center's educational programs. The program is open to students who have completed their sophomore year in college or who are near completion of a two-year community college degree. Applicants should have an interest in conducting research in the Earth Sciences. Areas of study include: terrestrial ecology, agricultural research, greenhouse gases, marine ecosystems, Earth systems education and biodiversity studies. Informal seminars and discussion will emphasize the program theme of Earth Systems Science. Minorities and women are especially encouraged to apply.

Participants will receive a stipend, travel reimbursement up to $400 and housing at Biosphere 2 Center in Oracle, Arizona.

CONTACT: Nancy Mager, Summer Internship Program, Biosphere 2 Center, Inc., PO Box 689, Oracle, AZ 85623; Phone: (520) 896-6408; Fax: (520) 896-6214; Email: nmager@bio2.edu

Celebrating 20th Century Pioneers in the Atmospheric Sciences: Examining 21st Century Challenges and Opportunities

Through funding from NASA's Earth Science Enterprise, Howard University is hosting a conference March 20–22, 2000 in Washington, DC entitled: ***Celebrating 20th Century Pioneers in the Atmospheric Sciences: Examining 21st Century Challenges and Opportunities.***

The purpose of this conference/workshop is to:

- Honor the accomplishments of the few minorities in this field;
- Assess minority status through discussions with colleagues, students, and representatives from professional societies, the private sector, and federal funding agencies; and
- Formulate a strategy for successful production of the next generation of minority atmospheric scientists.

Full travel awards are available for up to 70 students and postdocs. Attendance is encouraged for both students and professionals working in fields related to the atmospheric sciences, including: broadcast meteorology, academic research, government, and private sector.

CONTACTS: Dr. Vernon R. Morris, Laboratory for Atmospheres Code 916, NASA Goddard Space Flight Center; Phone: (301) 614-5548 or at Howard University; Phone: (202) 806-5450; Email: vmorris@physics1.howard.edu

Dr. Gregory S. Jenkins, Department of Meteorology, Penn State University; Phone: (814) 865-0479; Email: OSEI@ESSC.PSU.EDU

Center for Hydrology, Soil Climatology, and Remote Sensing's (HSCaRS) Undergraduate Summer Enrichment Program

http://space.hsv.usra.edu/SEP.html/Index.html

The Center for Hydrology, Soil Climatology, and Remote Sensing's (HSCaRS) at Alabama A&M University in Huntsville conducts an Undergraduate Summer Enrichment Program. This NASA-sponsored program provides summer research opportunities for undergraduate minority and women students in Earth system science. Interns are selected from a pool of highly qualified student applicants from across the nation. This program provides for an eight-week period of residence at Alabama A&M University, where students have the opportunity to work with an A&M or GHCC researcher/mentor in general research areas such as micrometeorology, soil data analysis, hydrologic modeling, geographic information systems, soil hydrology, or computer science. Research papers resulting from the interns' summer projects have been presented at various national conferences. Posters describing the program are mailed in January. Applications for the summer 2000 program are due by March 1, 2000.

CONTACT: Gloria Wortham, Global Hydrology and Climate Center, 977 Explorer Blvd., Huntsville, AL 35806-2807; Phone: (256) 922-5977; Email: gloria.wortham@msfc.nasa.gov

Earth Systems Field Research Experience for Undergraduates

The Earth Systems Science Field Research Experience for Undergraduates is held on the Juneau Icefield, Alaska from July 1 to August 24. This field program is for undergraduate geoscience students and emphasizes a combination of interdisciplinary field studies and student-involved research in Earth systems science. A key focus is the issue of global warming and the Juneau Icefield and its 39 main outflowing glaciers in the Alaskan Panhandle. This icefield is the fifth largest in the Western Hemisphere and accessible by foot and helicopter from Juneau, Alaska's capital city. The program is expeditionary in character and involves intense seven-day a week field work for the entire period. Some experience in living under adverse wilderness conditions and cross-country skiing is recommended. NASA-supported scholarships available, and some travel grants.

CONTACT: Maynard M. Miller, Glaciological and Arctic Sciences Institute, College of Mines and Earth Resources, University of Idaho, Moscow, ID 83844; Phone: (208) 882-1237; Fax: (208) 882-6207; Email: jirp@uidaho.edu

Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)

http://icp.giss.nasa.gov

ICP's mission is to contribute an innovative model for teaching and learning science that connects NASA's climate system research to national science standards and foster the professional/academic advancement of minority students in the sciences. The ICP is conducted in collaboration with the City University of New York (CUNY), Columbia University, New York City Public Schools, and Science Systems and Applications, Inc.

Student Research Interns and Faculty Fellows are competitively selected from New York City area pre-college and college institutions and given tangible roles on GISS research teams organized to advance our understanding of climate forcings and natural variability that produce climate change. Activities during Summer Institutes (six–eight weeks) and an Academic Year Program (GISS- and school-based) are designed to facilitate research projects and develop relevant science skills and content understandings. Annually, student researchers at GISS and/or ICP schools make presentations at science fairs, regional and national science competitions and the ICP Spring and Summer Conferences. ICP students view research experiences as a means to their advancement in the science pipeline, with program alumni now entering highly competitive schools and job markets. Throughout the year, ICP faculty and GISS scientists collaborate to produce student projects and lessons, as well to share them at professional meetings and conferences.

With the support of NASA's Minority University-SPace Interdisciplinary Network Resource Training Site at the City College of New York (CCNY), ICP schools are gaining the technical competencies and resources needed to participate in an electronically connected research and education network.

An Earth Climate Teacher Education Course and school-based Teacher Institutes are the newest components under development. The context for the course and institutes is to examine the Earth's climate as an evolving, dynamic system by investigating how the input solar radiation interacts with the system characteristics to produce the output climate conditions. Partnerships with Columbia University, CUNY and New York City Urban Systemic Initiative are contributing to these teacher courses and institutes.

CONTACT: Carolyn Harris, NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025; Phone: (212) 678-5653; Fax: (212) 678-5552; Email: charris@giss.nasa.gov

NASA Academy

http://www.nasa-academy.nasa.gov

NASA's Charter gives it the main role of using and exploring space for the benefit of humankind. The success of the space program results from the interaction of government, academia, and the private sector, each playing a critical and different role. Responsibilities overlap, leaders migrate from one sector to another, and interdependence changes with each new administration. ***The NASA Academy*** is a unique institute of higher learning whose goal is to help guide future leaders of our space program by giving them a glimpse of how this system works.

The intent of this program is to give the selected students a working knowledge of NASA and its programs. The Academy accomplishes this through interactive sessions with leaders within government, industry, and academia and research in NASA's laboratories. The students will discover how NASA and its Field Centers operate, understand the NASA link to the private sector, gain experience in world-class laboratories, participate in a team environment where people work together to accomplish common goals, and build professional bonds among our future leaders.

The NASA Academy was initially started in 1993 at Goddard Space Flight Center (GSFC). NASA Academies are currently active at GSFC, Dryden Flight Research Center, and Ames Research Center.

Student eligibility requirements include:

- A demonstrated interest in the space program;
- Enrollment (as of June 1 of the program year) as a junior, senior, or early graduate student;
- Minimum B average;
- A major in science (physics, chemistry, biology, etc.), mathematics, engineering, computer science, or other area of interest to the space program; and
- Citizenship or permanent residence (as of June 1 of the program year).

The NASA Academy Program is co-sponsored by the National Space Grant College and Fellowship Program, which provides students with stipends between $2,000 and $4,000 for the summer. Housing, meals and local transportation are paid for by the participating NASA Center.

CONTACT: For application materials, please check with your local Space Grant College Consortia Office at **http://calspace.ucsd.edu/spacegrant/** and the NASA Academy Home Page at **http://www.nasa-academy.nasa.gov** or —call the University Programs Office, NASA GSFC, at (301) 286-8733

National Workforce Development Education and Training Initiative

Building a strong work force to populate one of the fastest growing industries in the nation is one of the challenges facing NASA's Commercial Remote Sensing Program (CRSP) at Stennis Space Center. On October 1, 1999, CRSP, along with

NASA's Education and University Affairs Office at Stennis, announced a national program that is designed to meet that challenge.

The national plan is based on the successful approach demonstrated by the Mississippi Model for ***Workforce Development Education and Training*** (WDET), currently being implemented by CRSP's Mississippi Space Commerce Initiative. As NASA's lead center for commercial remote sensing, Stennis introduced WDET in the state of Mississippi two years ago. WDET has been given the task of ensuring that a trained workforce will be available to populate the rapidly growing remote-sensing industry. The Mississippi Model and the Mississippi Department of Education launched a program, which when fully implemented, will bring remote-sensing technology to every Mississippi student by 2003. This program has been the focus of national attention, bringing education officials from around the nation to Mississippi to observe the schools involved. Spatial Information Centers have been established in all Mississippi Community Colleges and Universities are investigating remote-sensing courses for existing disciplines.

NASA, the US Department of Education, the US Department of Labor, the US Department of Agriculture, the US Department of Interior and the US Department of Defense will work together to ensure that all students are exposed to remote-sensing technology. Industries, colleges and universities will also be part of the network. Additionally, NASA will draw on its existing partnerships with the Smithsonian Institution, National Geographic, the Public Broadcasting Service and the Global Learning and Observations to Benefit the Environment program.

CONTACT: Brenda Pounds, Stennis Space Center, Building 1200, Stennis Space Center, MS 39529; Phone: (228) 688-3814; Fax: (228) 688-7528;
Email: brenda.pounds@ssc.nasa.gov

NSU/NASA Research Experience in Earth System Science (REESS)

http://vigyan.nsu.edu/reess

A six-week program to educate Science, Mathematics, Engineering, and Technology (SMET) undergraduate students in the visualization and interpretation of satellite data. Students will be assigned research projects relevant to NASA's Earth Science Enterprise coupled with an intense educational program.

At the end of the experience the students are expected to a) have an understanding of the Earth as a coupled system in which many interactions are critical to climate change; b) understand satellite data manipulation, image processing, and interpretations; c) be capable of accessing satellite images via Internet and making informed interpretations. Research work in NSU's scientific visualization laboratories will be coupled with field trips to NASA Langley Research Center. Details of student projects from previous years can be found on the program's Web site.

Eligible candidates must 1) be a full time undergraduate student at a certified institution; 2) have completed a year of university level science and mathematics courses; and 3) be a US citizen. Applicants need to submit a completed application form; a resume; an unofficial copy of the college transcript and two letters of recommendation from a professor or a work supervisor. Application forms and a complete brochure will be available beginning in February 2000. The project will provide participants with the following support package: stipend—$1600 (for six weeks); Travel—From the city of residence to Norfolk, VA will be reimbursed to a maximum of $500; lodging: Dormitory housing at NSU and meal plans will be paid for. Commuters will receive meal plan only.

CONTACT: Dr. S. Raj Chaudhury, BEST Lab, Norfolk State University, 700 Park Avenue, Norfolk, VA 23504; Phone: (757) 683-2381; Fax: (757) 683-9054; Email: schaudhury@nsu.edu

OUR Earth: Opportunities for Undergraduate Research in Earth Systems Science

http://www.waspacegrant.org/ourearth.html

This program will provide summer research experiences to 14 talented undergraduate students each year, selected from a national pool of students from the range of disciplines involved in Earth system science. Selected students will receive room and board on the University of Washington campus and a stipend of $2000 for the 8-week program. Organized by the Washington Space Grant Consortium, this coordinated effort will include: direct student involvement with an ongoing NASA Earth Science research project; participation in a seminar series examining current issues in Earth system science with an emphasis on an integrated approach to understanding global change; opportunities for students to present their work orally and in multi-media formats; professional assistance to develop technical and presentation skills critical to a successful career in the sciences or related fields; opportunities to forge powerful connections with peers and faculty that may develop into lifelong professional and personal associations.

OUR Earth 2000 project information and application materials are available at the project Web site. The summer 2000 program will be held June 19–August 11 on the University of Washington campus in Seattle, Washington. The student application deadline is March 15, 2000. Successful applicants will be notified by April 15, 2000.

Juniors, seniors, or community college students who have completed two years of college level courses are eligible to apply. Student applicants should be majoring in any field related to Earth system science, or science education. Room, board, and a $2000 stipend will be provided to program participants.

Social activities and weekend excursions to some of the Seattle area's most beautiful sites will be organized for participants by program staff.

CONTACT: Lorien Gremore, Washington Space Grant, Box 351650, University of Washington, Seattle, WA 98195-1650; Phone: (206) 543-1943; Fax: (206) 543-0179; Email: nasa@u.washington.edu

Remote Sensing of Tribal Lands: Earth System Science Student Research Experiences at Salish Kootenai College

A partnership between Salish Kootenai College (SKC) and the Numerical Terradynamics Simulation Group (NTSG) at the University of Montana will provide research experiences in Earth system science to Native American undergraduate students starting in April of 2000 and continuing for three years. A new upper-division course ***Remote Sensing of Tribal Lands*** will be developed and taught within the SKC B.S. in Environmental Science degree program. This course will cover the application of remote-sensing technologies to the study of the Earth as a system, and will focus in particular on the place of Montana tribal lands in the Earth system. An estimated 15 students per year will gain research experience at an introductory level in this class through completion of a term research project that utilizes remote sensing, geographic information systems, and global positioning system technologies, and these students will become well prepared for more advanced research in this area. Six undergraduate research internships applying remote-sensing data and Earth system modeling to the solution of important environmental problems on tribal lands will also be provided each year. These students will work under the supervision of SKC and NTSG researchers, with some students based at SKC and some working at the NTSG facilities. A project Web site will be developed and maintained to publicize the educational opportunities in Earth system science at Salish Kootenai College, disseminate student research results and NASA Earth Observing System data products covering Native lands, and to emphasize the importance of NASA's Earth Science Enterprise to Native peoples.

CONTACT: Tim Olson, Salish Kootenai College, PO Box 117, Pablo, MT 59855; Phone: (406) 675-4800, ext. 305; Email: tim_olson@skc.edu

STEP Careers in Research Exploration Program

The purpose of this project is to expose the Montana Tech Succeeding Students in Engineering Programs ***(STEP)*** students to remote sensing and to spark their interest in research-based careers. STEP is a support program that works with traditionally underrepresented students to encourage them to succeed in earning an engineering education and becoming a successful professional. Each year the STEP program accepts twenty recent high-school graduates into the program. They attend classes and academic excellence workshops for six weeks in the summer while living on campus. The classes include but are not limited to, college success, introduction to engineering and English composition. Starting summer 2000, an additional class will be offered in the field of remote sensing. The majority of the class time will be spent conducting research with faculty members who are currently doing NASA research at Montana Tech.

Upon completion of the six-week summer program, all STEP students enroll at Montana Tech in one of the seven engineering programs offered. STEP works with students to develop academic and personal success strategies from college entrance until maturation and placement. Along with other STEP program requirements, students will write reports of their remote-sensing research experience and the careers that the experience may lead to, supported by a plan for reaching the career goal(s). The STEP program then tracks student's success at following their career goal plan and assists them in attainment of their objectives.

The objectives of the STEP Careers in Research Exploration Program are to:

- Enhance the knowledge of remote sensing and Earth system science of STEP participants through research;
- Develop students' ability to conduct scientific research;
- Encourage students to pursue an education in engineering or technology;
- Improve tribal technology, science, and mathematics education by providing positive Native American role models to high school students; and
- Expose students to the career opportunities available in the fields of remote sensing and Earth system science.

CONTACT: Principal Investigator, Dr. Thomas S. Moon, Professor, Geophysical Engineering, Montana Tech of the University of Montana, 1300 West Park Street, Butte, MT 59701; Phone: (406) 496-4350; Fax: (406) 496-4704; Email: tmoon@mtech.edu
or—STEP Program Director, Amy Verlanic, Technical Outreach Department, STEP Program, Montana Tech of the University of Montana, 1300 West Park Street, Butte, MT 59701; Phone: (406) 496-4289; Fax: (406) 496-4696; Email: averlanic@mtech.edu

Summer Institute on Atmospheric and Hydrospheric Sciences

http://neptune.gsfc.nasa.gov/~fj2pg/sum_inst.html

NASA's Goddard Space Flight Center (GSFC) convenes an annual summer institute for undergraduate students, which focuses on atmospheric and hydrospheric sciences. The first part of the program is a one-week series of lectures describing proposed areas of research in the basic areas of atmospheric and hydrospheric sciences, and is given primarily by GSFC scientists. Based on these lectures and perceived compatibilities, the students each select their mentor and desired area of research, which is negotiable. The next nine weeks are devoted to an intensive research project with their selected mentor. Students are required to present their results orally at a closing symposium, and in a written report.

The program is directed at undergraduates, majoring in one of the physical sciences, who are in their junior year at the time of application. However, all undergraduates are eligible to apply. No previous experience in atmospheric or hydrospheric sciences is needed.

There is no formal application form for this project. Applications should be submitted in the form of a letter containing the following information: 1) full name; 2) address and phone number at school; 3) permanent address and phone number at which you can always be reached; 4) current grade level; 5) current grade point average; 6) major field; 7) Social Security Number; 8) one-page typewritten statement of your professional goals and interests; 9) description of computer programming and laboratory experience, if any; 10) citizenship; 11) transcripts of any courses and grades; and 12) the names of two faculty members who know your work well and have been asked to provide letter of reference. The transcripts and letters of reference should be sent directly by the university and faculty members to the address below.

The deadline for receipt of applications is in February, with awards announced in March. All applications receive consideration, without regard to race, color, age, national or ethnic origin, or sex.

CONTACT: Per Gloersen, NASA Goddard Space Flight Center, Code 971, Greenbelt, MD 20771; Phone: (301) 614-5710; Fax: (301) 614-5644; Email: per.gloersen@gsfc.nasa.gov

Visiting Student Enrichment Program

The Visiting Student Enrichment Program (VSEP) offers students summer employment with the Universities Space Research Association (USRA), working with NASA Goddard Space Flight Center's (GSFC) scientists. Student projects have included simulating a neural network, preparing image analysis algorithms on supercomputers, developing computational science applications, and creating interactive World Wide Web sites.

Project experiences are available each summer for a ten-week period, (high school students may start/stop one-two weeks later) at GSFC in Greenbelt, MD. The first, the individual research experience, matches one student with a staff member as a mentor to work on a project. The second, the group research experience, places up to six students in a team that will work on a project under the supervision of a staff member. Both paths provide opportunities to work with scientists and professionals at a world-class facility while offering a meaningful work experience primarily focused on computer science or the application of computers to solve problems in other sciences. VSEP will also offer field trips and lectures to broaden appreciation for the GSFC mission and activities.

The Program is open to full-time students in computer science, the physical sciences, and mathematics. All students will be evaluated relative to their school-level peers. Participants must be either U.S. citizens or foreign nationals in U.S. schools who possess a work visa. An annual announcement solicits application materials, which are typically due in January.

CONTACT: Visiting Student Enrichment Program, USRA, Mail Code 930, NASA/Goddard Space Flight Center, Greenbelt, MD 20771; Phone: (301) 286-4403; Email: VSEP@cesdis.usra.edu

GRADUATE

Celebrating 20th Century Pioneers in the Atmospheric Sciences: Examining 21st Century Challenges and Opportunities

Through funding from NASA's Earth Science Enterprise, Howard University is hosting a conference March 20–22, 2000 in Washington, DC entitled: ***Celebrating 20th Century Pioneers in the Atmospheric Sciences: Examining 21st Century Challenges and Opportunities.***

The purpose of this conference/workshop is to:

- Honor the accomplishments of the few minorities in this field;
- Assess minority status through discussions with colleagues, students, and representatives from professional societies, the private sector, and federal funding agencies; and
- Formulate a strategy for successful production of the next generation of minority atmospheric scientists.

Full travel awards are available for up to 70 students and postdocs. Attendance is encouraged for both students and professionals working in fields related to the

atmospheric sciences, including: broadcast meteorology, academic research, government, and private sector.

CONTACTS: Dr. Vernon R. Morris, Laboratory for Atmospheres Code 916, NASA Goddard Space Flight Center; Phone: (301) 614-5548 or at Howard University, Phone: (202) 806-5450; Email: vmorris@physics1.howard.edu

Dr. Gregory S. Jenkins, Department of Meteorology, Penn State University; Phone: (814) 865-0479; Email: OSEI@ESSC.PSU.EDU

Earth System Science Fellowship Program

http://earth.nasa.gov/nra/current/graduate/index.html

NASA offers graduate student training fellowships for persons pursuing Master of Science (M.Sc.) or Doctoral (Ph.D.) degree in Earth system science. The purpose of these fellowships is to ensure continued training of interdisciplinary scientists to support the study of the Earth as a system. Over 450 Ph.D. and M.Sc. fellowships have been awarded since the inception of the program in 1990.

NASA's Earth Science Enterprise (ESE) supports basic and applied research in the following areas:

- Biology and Biogeochemistry of Ecosystems and the Global Carbon Cycle
- Climate Variation and Prediction
- Global Water and Energy Cycle
- Solid Earth and Natural Hazards
- Ozone and Atmospheric Chemistry

Applications will be considered for research in atmospheric chemistry and physics, ocean biology and physics, ecosystem dynamics, hydrology, cryospheric processes, geology, geophysics, and information science and engineering, provided that the specific research topic is relevant to NASA's Earth remote sensing science, process studies, modeling and analysis in support of the U.S. Global Change Research Program (USGCRP). NASA discourages submission of paleoclimate related applications to this program. Additional information about the ESE scientific priorities and its centerpiece, the Earth Observing System (EOS), can be found at **http://earth.nasa.gov/** and **http://eospso.gsfc.nasa.gov/.**

Students admitted or enrolled in a full-time M.Sc. and/or Ph.D. program at accredited U.S. universities are eligible to apply. Participants are competitively selected based on their submitted research proposal and their academic credentials. The deadline for application is March 15 of each year; the results are announced by June 30, with an anticipated award date of September 1 of the same year.

Awards are made initially for one year and may be renewed annually, no more than two additional years for a total of three years, based on satisfactory progress as reflected in academic performance and evaluations by the faculty advisor. The amount of the award is $22,000/annum, which may be used to defray student's stipend, living and educational expenses, travel expenses to scientific conferences, tuition, and fees.

CONTACT: Earth System Science Fellowship Program, Code Y, NASA Headquarters, Washington, DC 20546; Phone: (202) 358-0855; Email: acrouch@hq.nasa.gov

Graduate Student Summer Program (GSSP) in the Earth System Sciences

http://www.usra.edu/gssp/

Goddard Space Flight Center's (GSFC's) Earth Sciences Directorate, in conjunction with the Universities Space Research Association (USRA), sponsors a ten-week ***Graduate Student Summer Program in the Earth System Sciences.*** Participating students work on an intensive research project at GSFC for the majority of the program period. Each student is given significant latitude to choose from a pool of research projects and mentors. Project topics are developed and implemented in conjunction with scientists from the three Earth science laboratories at GSFC: The Laboratory for Atmospheres, the Laboratory for Terrestrial Physics, and the Laboratory for Hydrospheric Processes. During the project period, all participating students are invited to lunchtime sessions with a variety of GSFC researchers. Students are expected to produce oral and written reports on their summer research activities. The written reports are intended to be shared with members of the global change research community and subsequent program participants.

The program is open to all students enrolled in, or accepted to, an accredited graduate program in the physical or biological processes, mathematics, computer science, or engineering. In addition, the first five days of the summer program are dedicated to an intensive public lecture series, which is designed to provide a comprehensive introduction to the science and techniques of remote-sensing and satellite observations. Students must commit to the full ten-week program. Because of NASA GSFC security regulations, citizens of certain proscribed nations may be ineligible.

Students are selected on the basis of academic record; proven motivation and qualification to pursue interdisciplinary or multidisciplinary research related to Earth sciences; clarity and relevance of research interests to NASA programs; and letters of recommendation.

CONTACT: GSSP Coordinator, Universities Space Research Association, 7501 Forbes Boulevard, Suite 206, Seabrook, MD 20706; Phone: (301) 805-8396; Fax: (301) 805-8466; Email: gssp@gvsp.usra.edu

NASA Academy

http://www.nasa-academy.nasa.gov

NASA's Charter gives it the main role of using and exploring space for the benefit of humankind. The success of the space program results from the interaction of government, academia, and the private sector, each playing a critical and different role. Responsibilities overlap, leaders migrate from one sector to another, and interdependence changes with each new administration. ***The NASA Academy*** is a unique institute of higher learning whose goal is to help guide future leaders of our space program by giving them a glimpse of how this system works.

The intent of this program is to give the selected students a working knowledge of NASA and its programs. The Academy accomplishes this through interactive sessions with leaders within government, industry, and academia and research in NASA's laboratories. The students will discover how NASA and its Field Centers operate, understand the NASA link to the private sector, gain experience in world-class laboratories, participate in a team environment where people work together to accomplish common goals, and build professional bonds among our future leaders.

The NASA Academy was initially started in 1993 at Goddard Space Flight Center (GSFC). NASA Academies are currently active at GSFC, Dryden Flight Research Center, and Ames Research Center.

Student eligibility requirements include:

- A demonstrated interest in the space program;
- Enrollment (as of June 1 of the program year) as a junior, senior, or early graduate student;
- A minimum B average;
- A major in science (physics, chemistry, biology, etc.), mathematics, engineering, computer science, or other area of interest to the space program; and
- Citizenship or permanent residence (as of June 1 of the program year).

The NASA Academy Program is co-sponsored by the National Space Grant College and Fellowship Program, which provides students with stipends between $2,000 and $4,000 for the summer. Housing, meals and local transportation are paid for by the participating NASA Center.

CONTACT: For application materials, please check with your local Space Grant College Consortia Office at **http://calspace.ucsd.edu/spacegrant/** and the NASA Academy Home Page **http://www.nasa-academy.nasa.gov** or —call the University Programs Office, NASA GSFC, at (301) 286-8733

NASA Summer School for High Performance Computational Earth and Space Sciences

http://cesdis.gsfc.nasa.gov/

The NASA Goddard Space Flight Center's Earth and Space Data Computing Division (ESDCD) and the Universities Space Research Association (USRA) annually solicit applications from qualified graduate students to participate in an intensive summer lecture series in computational Earth and space sciences. The ESDCD provides comprehensive research and development support in data handling and computing for NASA Earth and space science research programs. Resident facilities include a 1024-processor Cray T3E, a Cray J90 cluster composed of three 32-processor Cray J90 systems, and several Beowulf-class systems (Beowulf is a class of inexpensive massively-parallel systems designed as a cluster of commodity PC's using LINUX). This program stems from ongoing activities that reflect NASA's desire to help train the next generation of Earth and space scientists in the development of computational techniques and algorithms for scalable parallel computers in support of the Federal High Performance Computing and Communications Program.

Approximately 15 students are selected annually to participate in the three-week program. The program aims to attract Ph.D. students in the Earth and space science disciplines whose present or future research requires large-scale numerical modeling on massively parallel architectures. Eligibility is normally limited to those Earth and space science students who are enrolled in U.S. universities and who have passed their Ph.D. qualifying exams. Because of NASA GSFC security regulations, citizens of certain prescribed nations may be ineligible. Students are given hands-on computer training and small group interaction experience. Experienced computational scientists present a series of lectures on advanced topics in computational Earth and space sciences, with emphasis on computational fluid dynamics and particle methods. Vendors present lectures on developing software for their massively parallel architectures. Both the Cray T3E and the Beowulf systems are available for use by the students.

Students receive a per diem and will be reimbursed for domestic transportation to and from Greenbelt, Maryland. Students are housed near Goddard Space Flight Center and transportation to and from Goddard each day is provided.

CONTACT: Georgia L. Flanagan, Program Coordinator, USRA/HPCP, Code 930.5, NASA Goddard Space Flight Center, Greenbelt, MD 20771; Phone: (301) 286-2080; Email: georgia@cesdis.usra.edu

National Research Council (NRC) Resident Research Associateship (RRA) Programs

http://www.national-academies.org/rap

The *NRC* conducts a national competition to recommend and make awards to outstanding scientists and engineers at recent postdoctoral and experienced senior levels for tenure as guest researchers at participating NASA laboratories. Recent postdoctoral graduates are provided with an opportunity for concentrated research in association with selected members of the permanent professional laboratory staff, often as a climax to formal career preparation. Recent doctoral recipients as well as experienced Ph.D. scientists and engineers are afforded an opportunity for research without the interruptions and distractions of permanent career positions. The *RRA* program is administered by the National Research Council under a contract monitored by NASA's Education Division.

This program is open to all Ph.D.s, or equivalent, in science and engineering disciplines relevant to NASA research programs, including NASA's Earth Science Enterprise. As many as 200 NRC-NASA Associates are on tenure annually. All opportunities for research at NASA Centers are open to U.S. citizens and U.S. legal permanent residents; many of the opportunities are also open to other non-U.S. citizens.

Applicants must submit a research proposal that responds to a specific research opportunity at the desired NASA Center. These research opportunities are published annually in brochures for each Center and on the Internet at **http://www.national-academies.org/rap.** Awardees must hold a Ph.D., Sc.D., or other earned research doctoral degree recognized in U.S. academic circles as equivalent to the Ph.D., or must submit acceptable evidence of completion of all formal academic requirements for one of these degrees before tenure may begin. Applications, submitted directly to the NRC, are accepted on a continuous basis. The following is the general schedule for this program:

Applications postmarked by	Will be reviewed in
April 15	late June
August 15	late October
January 15	late February

CONTACT: National Research Council, Associateship Programs–TJ 2114, 2101 Constitution Avenue, NW, Washington, DC 20418; Fax: (202) 334-2759

Visiting Student Enrichment Program

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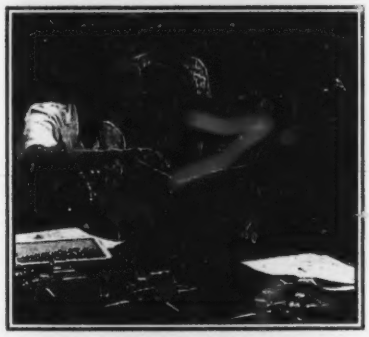
Project experiences are available each summer for a ten-week period, (high school students may start/stop one-two weeks later) at GSFC in Greenbelt, MD. The first, the individual research experience, matches one student with a staff member as a mentor to work on a project. The second, the group research experience, places up to six students in a team that will work on a project under the supervision of a staff member. Both paths provide opportunities to work with scientists and professionals at a world-class facility while offering a meaningful work experience primarily focused on computer science or the application of computers to solve problems in other sciences. VSEP will also offer field trips and lectures to broaden appreciation for the GSFC mission and activities.

The program is open to full-time students in computer science, the physical sciences, and mathematics. All students will be evaluated relative to their school-level peers. Participants must be either U.S. citizens or foreign nationals in U.S. schools who possess a work visa. An annual announcement solicits application materials, which are typically due in January.

CONTACT: Visiting Student Enrichment Program, USRA, Mail Code 930, NASA/Goddard Space Flight Center, Greenbelt, MD 20771; Phone: (301) 286-4403; Email: VSEP@cesdis.usra.edu

TEACHER/FACULTY PREPARATION AND ENHANCEMENT



Teacher preparation and enhancement activities are a key part of NASA's Earth Science Enterprise Education Program. Pre-service programs provide an opportunity for Earth system science to be included as part of a teacher's degree program or certification, as well as in-service, continuing education activities and programs that update skills, enrich, and strengthen the theoretical and practical basis for classroom and laboratory instruction. Programs include workshops, courses, internships, and other activities that encourage incorporating Earth system science content into existing courses and curriculum related to science, mathematics, engineering, and technology.

NASA also sponsors programs designed for college and university faculty, to enrich their scientific and technical expertise and help them to establish NASA research contacts. These programs include workshops and working experiences at NASA Centers.

PRE-SERVICE

Concepts and Pedagogical Strategies in Earth System Science Education for K–7 Teachers

This summer workshop at West Chester University of Pennsylvania is designed for pre-service and in-service K–7 teachers to enhance their understandings about Earth system science, develop abilities in Earth system science education (ESSE), and develop an ESSE Action Plan for their grade level.

Participants will explore key questions related to Earth system science, use state-of-the-art technologies to observe and study the Earth system in real time, and learn ways to construct and utilize real-time satellite images for ESSE lessons. They will receive and practice using NASA teaching materials designed for Earth system science education, learn how to access NASA education materials, and revise the materials as constructivist inquiry-based ESSE lessons. By the end of the workshop, each participant will complete an ESSE action plan for their grade level using workshop materials, concepts, skills, and pedagogical strategies.

The workshop meets Wednesdays from June 30 through July 28. There are also several one-day field trips, including a visit to the NASA Educator Resource Center at Goddard Space Flight Center. Participants can receive one undergraduate credit or one Continuing Education Credit for the workshop (cost waived by West Chester University).

CONTACT: Richard M. Busch, Department of Geology & Astronomy, West Chester University, West Chester, PA 19383; Phone: (610) 436-2716; Fax: (610) 436-3036; Email: rbusch@wcupa.edu

Consortium for the Application of Space Data to Education (CASDE)

A wide variety of training opportunities for pre-service and in-service teachers are available through the ***Consortium for the Application of Space Data to Education (CASDE).*** This consortium was created to provide mechanisms to integrate NASA's extensive data holdings and advanced information system technologies into education. CASDE is

dedicated to providing the educational community with vast amounts of NASA imagery, tools, educational resources, and interdisciplinary activities. CASDE tools, tutorials, a useful "building-block" curriculum structure, classroom ready posters, and interactive laboratory kits, have all been developed by the consortium to introduce the basics of interpreting space imagery and incorporating potential applications of NASA data to the education community and other interested parties.

The leadership of CASDE comes from three organizations, including the University of Nebraska at Lincoln, Center for Advanced Land Management Information Technologies, the Jet Propulsion Laboratory, and the University of Nebraska at Omaha Office of Internet Studies. Through these three organizations, the CASDE staff offers a variety of periodic staff development opportunities for educators (both pre-service and in-service) and other professionals (such as resource managers), who are interested in gaining more information or training-related CASDE resources. For example, one-day introductory seminars are available that introduce participants to CASDE imagery resources, sample curriculum activities, and software. Weeklong workshops are also offered periodically to provide teachers and other professionals a more in-depth training in CASDE resources, image visualization tools, and lesson design. The workshops also assist teachers in developing curriculum specific to their classrooms. In addition to these shorter duration opportunities, several graduate courses, and extended independent study classes for graduate credit, are also available from the University of Nebraska at Omaha. Web-based training opportunities, called "Webshops" are also being developed by the consortium. Within all the training opportunities, educators are involved in a wide variety of "hands-on" activities to help support a strong base of CASDE resource awareness, experience, and classroom integration. Participants particularly gain valuable experience with new technology-based tools, such as DataSlate, which is a new technology that allows users to explore essentially infinite data sets and to simultaneously compare co-registered and geo-referenced sets of data. DataSlate is being developed by the Jet Propulsion Laboratory.

CASDE invites partnering with other organizations to help provide such teacher training opportunities in various locations, and actively seeks collaboration with teachers and other professionals who are interested in expanding CASDE curriculum efforts.

CONTACTS: Paul Clark, Office of Internet Studies, UNO, Omaha, NE, 68182-0163; Email: Paul_Clark@unomaha.edu

Rick Perk, University of Nebraska, Lincoln, 113 Nebraska Hall, Lincoln, NE 68588-0517; Email: rperk@tan.unl.edu

Earth Science Enterprise Research Program—University of Montana

The University of Montana (UM) provides a technology learning center for professional teacher training and teacher in-service, which brings remote-sensing and basic Geographic Information System (GIS) applications into the classroom. Using data products provided by UM's Numerical Terradynamic Simulation Group (NTSG) and supplementing ongoing educational programs, UM's learning center introduces the latest remote-sensing concepts to the next generation of science classrooms in Montana.

UM has developed an online, for credit, course program for pre-service and in-service education of the teachers of Montana, as well as the technical components to expand this program nationally and internationally. This project brings online Earth system science courses developed by the Center for Educational Technologies at Wheeling Jesuit University into the UM learning environment, presented through the e-College™ network.

Additionally, the project plans outreach and study of online courses for the Montana Native American population, working closely with several reservations across Montana. During the first year, the project will focus on one reservation and then expand over the three-year program to integrate operations in state and national hosts. Immediate impact is expected on Montana classrooms, with plans to explore the impact on Native American classrooms where special conditions and constraints may prevail. Project evaluation will delve deeply into the perceived meaning of scientific understandings in the Native American teaching corps and examine how these meanings are communicated in their classrooms.

CONTACT: John Kuglin, Director of Educational Outreach, or Wes Snyder, Research Professor of Education, University of MT, James E. Todd Building, Missoula, Montana 58912; Phone: (406) 243-6334; Fax: (406) 243-2047; Email: jkuglin@selway.umt.edu

Earth System Science Online Course: An Opportunity in Geography Education

http://www2.una.edu/geography

The goal of this project is to offer K–12 teachers of geography, Earth science, social studies and other related subjects the opportunity to increase their content knowledge in the field of Earth system science in a convenient, technology-enhanced environment. The objectives are to:

- Increase K–12 teachers' knowledge of, and experience in, Earth system science;
- Provide teachers in underserved areas of Alabama, the southeast and other areas an opportunity to take a graduate level class in Earth system science;

- Enhance K–12 teachers' use of the Web and source material available through various governmental, private industry and educational organizations;
- Offer pre-service education students the opportunity to increase their content knowledge in Earth system science, while trying a new delivery method; and
- Test and demonstrate the power of the Internet and World Wide Web as a complete delivery system mechanism for Earth system science instruction.

Admittance to the graduate program at the University of North Alabama is a requirement of participation. It is anticipated that the course will be offered starting with the fall semester 2000.

In addition to delivering the existing Earth system science online course that has been developed by the Center for Educational Technologies at Wheeling Jesuit University, the course will bring an additional focus on the use of the Essential Elements of the National Geography Standards.

CONTACT: Dr. William R. Strong, Box 5064, Department of Geography, University of North Alabama, Florence, AL 35632-0001; Phone: (256) 765-4218; Fax: (256) 765-4911; Email: wstrong@unanov.una.edu

Earthworks: Earth System Science for Secondary Teachers

This one-week workshop provides an opportunity for teachers to investigate Earth system science, the interaction between Earth, atmosphere, oceans, life forms, and space. Participants will work with scientists and each other to develop their understanding and appreciation of the Earth. This workshop is designed for pre-service and new in-service teachers, who are interested or involved in teaching secondary science. It will be held in the mountains above Boulder, Colorado during the summer of 2000.

This workshop is guided by the philosophy that students learn through active involvement with real life experience, and that teachers should provide students with rich learning experiences that will allow them to explore Earth system science. Recognizing that teachers often teach in the same way in which they were taught, our aim is to provide a learning experience for educators that models sound educational practice.

The goals of this interactive, process-oriented workshop are to provide teachers with a self-directed learning experience in which they can develop an understanding of Earth systems and share that understanding with others; and to foster an ongoing community, including teachers and scientists, that will be maintained throughout the school year.

Cost to participants will be minimal (most expenses will be covered, including child care), however, those with high transportation expenses may need to find additional sources of funding.

CONTACT: Dr. Alex Weaver, CIRES, Campus Box 216, University of Colorado, Boulder, CO 80309; Phone: (303) 492-5431; Fax: (303) 492-1149; Email: alex.weaver@colorado.edu

An Interdisciplinary Teacher Training Program on Earth System Science Using Information Technology

http://www.pitt.edu/~aap/announce.html

The University of Pittsburgh at Bradford is offering a one-week interdisciplinary summer workshop on Earth system science aimed at preparing pre-service education students and in-service teachers for the 21st Century. The objective of this interdisciplinary teacher-training course is to develop in students an understanding of the Earth processes shaping the past, present, and future. The course provides hands-on training and experience in applied environmental problem-solving through field work, lab practicals, and space-based technology.

Annually, from 2000–2002, the university will solicit a group of 16 motivated, energetic pre-service and in-service science teachers who wish to grow professionally. The program is open at a national level to everyone qualified to apply. The major selection criterion is the potential for integration of the program materials into the participants' instructional activities. Minorities and women are strongly encouraged to apply, as well as those who teach Earth science to communities underrepresented in science education. The 2000 workshop will be held July 9–14.

Teachers who are accepted into the program have their tuition and room and board underwritten by the NASA grant. Successful participants will be awarded one college credit for pre-service or 55 hours of continuing education credit/contact time for in-service participants.

The scientific team conducting this teacher-training program consists of seven faculty members from scientifically diverse backgrounds: one Pitt-Bradford geology and environmental scientist, a chemist from Pitt-Bradford, the Pitt-Bradford Director of Education Program, a research librarian from Pitt-Bradford, a biologist from Mercyhurst college, a Geographic Information System Specialist from Northern Illinois University, and a meteorologist from The Pennsylvania State University.

CONTACT: To apply, use the electronic application form at: **http://www.pitt.edu/~aap/announce.html** or contact: Dr. Assad Panah, Professor & Director, Department of Geology and Environmental Science, University of Pittsburgh at Bradford, 300 Campus Drive, Bradford, PA 16701; Phone: (814) 362-7569; Fax: (814) 362-5088; Email: aap+@pitt.edu

The JMU DEVELOP Center—Digital Earth

The Digital Earth is a virtual representation of our planet that enables a user to explore and interact with the vast amounts of natural, cultural, and historical information being gathered about the Earth. The Digital Earth initiative brings together Federal Agencies, private and not-for-profit institutions, and other contributors to facilitate the development of the technology, standards, and content necessary for realization of the Digital Earth.

The JMU DEVELOP Center focuses on student-oriented research that blends course work and capstone experiences, faculty and student investigations, and industrial experiences. Towards that end, the JMU DEVELOP Center provides:

- Student and teacher access to interagency data;
- Inspiration of individuals to learn about the Earth through center activities;
- Promotion of Digital Earth technology on a local, state, regional, national, and international level;
- The "bridge" between public outreach and education, and Digital Earth technologies;
- Instructional videos and multimedia;
- Computer lab to complete educational activities;
- Virtual reality interfaces;
- NASA research and information; and
- Set of planned activities based on educational level.

JMU will offer a one-week digital Earth workshop for pre-service teachers and a small group of in-service teachers the third week of June 2000 at James Madison University.

CONTACT: James L. Barnes, James Madison University, Harrisonburg, VA 22807; Phone: (540) 568-3154; Fax: (540) 568-2747; Email: barnesjl@jmu.edu

Mathematics of the Dismal Swamp Project

The Mathematics of the Dismal Swamp Project supports a team of professors from Elizabeth City State University to use research on The Great Dismal Swamp Project as a platform for development of a mathematics education course that incorporates a generic wetlands application. The focus of the project is to improve pre-service math education students' understanding of the interdisciplinary nature (includes biology, organisms and aquatic levels; chemistry; geoscience, estuaries and swamp; and mathematics and analysis of the data) associated with Earth system science. Four new modules will be developed, which include an interdisciplinary approach for incorporating Earth system science in the targeted mathematics education course.

The project is sponsored by The NASA Earth Science Enterprise (ESE) Education Program, Elizabeth City State University, and the Minority University-Space Interdisciplinary Network (MUSPIN) Office of Goddard Space Flight Center.

CONTACT: Dr. Linda Bailey Hayden, NASA Network Resources and Training Site, Elizabeth City State University, Box 672, 1704 Weeksville Road, Elizabeth City, NC 27909; Phone: (252) 335-3696; Fax: (252) 335-3790; Email: lhayden@umfort.cs.ecsu.edu

Mission Possible: Earth System Science, the Curriculum, and You

This three-week interim course is intended to provide pre-service elementary and middle-school teachers with the opportunity to become familiar with the interdisciplinary field of Earth system science. The course will provide participants with hands-on training with NASA curriculum support materials and introduce them to national and local resources, with help from education specialists from the South Dakota Space Grant Consortium and NASA Johnson Space Center. Representatives from EROS Data Center (EDC) will provide educational materials and training on EDC resources. Participants will learn how to use the interactive multimedia technology resource—*The Voyage of the Mimi*—an integrated set of concepts that involve students in math, science, social studies, and language arts related to Earth system science. The opportunity to become proficient in the use of image processing in the classroom will also be provided. Eligible participants are pre-service elementary and middle-school students at Augustana College and other colleges in the South Dakota Space Grant Consortium participating in the interim course concept.

The cost of tuition is included in the annual tuition costs for each student—no extra costs are anticipated. Students from other colleges will pay room and board, however room and board is available for up to three visiting students.

CONTACT: Valerie Keeling Olness, Department of Biology, Augustana College, 2001 Summit Avenue, Sioux Falls, SD 57197; Phone: (605) 336-4720; Fax: (605) 336-4492; Email: olness@inst.Augie.edu

NASA RISE

http://www.cisat.jmu.edu/projects/nasa

NASA RISE of the College of Integrated Science and Technology at James Madison University offers a variety of pre-service and in-service workshops for students preparing to be science, mathematics and technology teachers and practicing teachers, supervisors, curriculum developers, and school administrators. These workshops focus on NASA Earth system science and related SMET content, implementation of national standards in science, mathematics, and technology, scientific visualization, instructional and

information technology, remote sensing, and geographic informations science. Workshops will help teachers to:

- Learn through minds-on, hands-on modeling and demonstrating experiences, innovative instruction, content, technology and the use of technology in teaching with NASA Earth science curriculum materials, data, and information;
- Practice and replicate innovative instruction, content, educational technology and the use of technology in teaching with NASA Earth science curriculum materials, data, and information; and
- Learn how to develop innovative instruction that is based on the national standards and benchmarks for mathematics, science, and technology and involves the research and development areas of NASA's Earth Science Enterprise and other NASA resources.

CONTACT: James L. Barnes, Director, NASA RISE, College of Integrated Science and Technology, 701 Carrier Drive, MSC 4102, James Madison University, Harrisonburg, VA 22807; Phone: (540) 568-3154; Fax: (540) 568-2761; Email: barnesjl@jmu.edu

NOVA Online Earth System Science Courses

CONTACT: Michael Odell, NOVA, University of Idaho, College of Education, Moscow, ID 83844-3082; Phone: (208) 885-6786; Fax: (208) 885-0560

Pan American Center for Earth and Environmental Sciences (PACES)

http://www.geo.utep.edu

The University of Texas at El Paso (UTEP) is involved in several initiatives to improve science education within the El Paso area public schools. These include outreach efforts into the classrooms; training programs for in-service teachers; and the introduction of a strong pre-service Science Core Curriculum. This project combines the goals of these initiatives into a multi-year series of Earth system science workshops for pre-service and in-service teachers using NASA Earth Science Enterprise materials and materials developed specifically for this region through the ***Pan American Center for Earth and Environmental Sciences (PACES)***, a NASA-funded University Research Center. Five workshops will present an Earth system science perspective using NASA and UTEP materials. Each workshop will focus on one aspect of Earth system science: an introductory workshop; the lithosphere; the biosphere; the atmosphere and hydrosphere; and astronomy. A sixth, and final, workshop will consist of a field trip to the NASA Regional Educator Resource Center maintained by the New Mexico Space Grant Consortium located at New Mexico State University in Las Cruces, New Mexico. The El Paso area satellite images processed by PACES and the lesson plans developed by the workshop participants will be available via the PACES Web site at UTEP.

The workshop is free, participants are selected competitively.

CONTACT: Vicki Harder, Principal Investigator, University of Texas at El Paso, El Paso, TX 79968; Phone: (915) 747-5746; Fax: (915) 747-5305; Email: vharder@geo.utep.edu
or—Sally Blake, Co-Investigator, University of Texas at El Paso, El Paso, TX 79968; Phone: (915) 747-7675; Fax: (915) 747-5305; Email: sblake@utep.edu

Planet Earth: A Science and Methods Course for Pre-Service and In-Service Teachers

http://k12s.phast.umass.edu/~nasa

The ***Planet Earth*** course will serve pre-service teachers and in-service teachers (grades four–nine). This program will be offered for the third and probably last time during summer 2000, from August 14–18, 2000.

Each day will focus on an important Earth system area: acid rain, global warming, the water cycle, oceans and climate, and planetary environments. The content sessions will employ student-active learning methods, and will be integrated with Web based, hands-on, and field-based activities. The day ends with an examination of related classroom issues such as the curriculum frameworks and assessment. Each participant will develop and implement a lesson plan or curriculum unit during the fall semester.

In-service teachers will participate in a fall semester program of classroom Earth systems research plus two Saturday workshops. They will be eligible for three graduate credits in Geosciences or Education or 42 "Professional Development Points." Pre-service teachers will attend academic year workshops devoted to additional science teaching methods. They will receive three credits for Education 462, Elementary Science Methods.

CONTACT: To register, contact Eugenie Harvey, Phone: (413) 545-1290; Email: eharvey@k12s.phast.umass.edu
Questions should be addressed to: Morton Sternheim; Phone: (413) 545-1908; Email: mort@k12s.phast.umass.edu

PULSE of the Planet—A Project to Prepare Undergraduates for Learning the Systems of Earth

Although this project will use NASA's four strategic enterprises as organizational themes, emphasis will be on NASA's Earth science program. A team of geologists, environmental scientists, and educators from the University of Tennessee at Chattanooga (UTC) will evaluate selected undergraduate courses and propose substantive modifications reflecting innovative delivery systems and instructional strategies. By including core content and general education courses, the project will have the opportunity to recruit potential teacher candidates from the general college population, with an emphasis on recruiting minorities.

The Challenger Center for Space Science Education's (CCSSE) Encounter Earth mission will provide a context for organizing and integrating content themes associated with the Earth's land surface, oceans, atmosphere, ice sheets and living systems. The project will explore ways of using this simulated space mission in college level science instruction while preparing teachers in the burgeoning area of science and technology research associated with the Earth's systems.

The faculty associated with the project will work closely with the staff of the Challenger Learning Center at UTC while participating in pre-and post-mission activities in area schools. The project will have a middle school focus although K–12 implications of NASA's strategic enterprises will require that we examine a wide range of courses. CCSSE will play a major role in the dissemination of instructional products developed through this initiative.

CONTACT: Bernard W. Benson, Ph.D., University of Tennessee at Chattanooga, 615 McCallie Avenue; The Challenger Learning Center; Chattanooga, TN 37403-2598; Phone: (423) 755-4237; Fax: (423) 785-2190; Email: Bernard-Benson@utc.edu

Summer of Seasons

http://vigyan.nsu.edu/bestfest

A series of workshops to provide emerging educators with the familiarity and knowledge to utilize curriculum materials in the classroom that have been developed for topics in Earth system science. The following fundamental skills will be introduced and reinforced as necessary:

- Use of Internet to access data from NASA's Distributed Access Archive Centers (DAAC);
- Use of image processing and scientific visualization software (e.g. SEES Image, WorldWatcher); and application of scientific method of inquiry in teaching Earth system science; and
- Technology integration for effective instruction for K–12 science and mathematics (including use of graphing calculators and microcomputer based laboratories).

Upon completion of the workshops all participants will receive free copies of NASA educator materials including a field test version of the DAACeSS CD-ROM jointly developed by NSU and NASA Langley Research Center. Also included is a B.E.S.T. Lab publication Science Writing Tips to help students write better scientific reports. There is no cost to participate.

CONTACT: S. Raj Chaudhur; Email: schaudhury@nsu.edu or—Dr. Gae Golembiewski; Email: ggolem@ger.nsu.edu; B.E.S.T. Lab, Norfolk State University, 2401 Corprew Avenue, Norfolk, VA 23504; Phone: (757) 823-2381; Fax: (757) 823-9054

ELEMENTARY & SECONDARY

Above and Beyond

http://www.cameron.edu/nasa.osgc/

Above and Beyond is an advanced space science course for K–12 teachers, which focuses on the excitement of NASA's Earth Science Enterprise to motivate students. Course topics cover history of space flight, principles of flight, aircraft as their orbits and their business, remote sensing: principles and practice. Guest lecturers include remote-sensing scientists, NASA Specialists in classroom application of remote sensing, NASA Aerospace Education Specialists, and Oklahoma NASA Space Grant Consortium professors.

CONTACT: Victoria Duca-Snowden, Director, Oklahoma Space Grant Consortium, Oklahoma Climatological Survey, College of Geosciences, 710 Asp, Suite 5, Norman, OK 73069; Phone: (405) 447-8483; Fax: (405) 447-8455; Email: vduca@ou.edu

Access Earth

http://www.usm.maine.edu/coe/mecats/earth/

Access Earth is a program for high school students with disabilities and teachers to encourage students with disabilities to enter careers in Earth system science. Students and teachers attend an intensive week-long summer institute focusing on land-ocean-atmosphere interactions, with field activities based at the Wells National Estuarine Research Reserve on the coast of Maine. Topics to be covered include climate change and sea level rise, land use changes, atmospheric pollution, and coastal watershed management. Participating teachers will work with scientists, educators, and students with disabilities to develop, test, and refine accessible Earth system science curriculum.

Students will work with scientists, collecting and analyzing scientific data, and will learn about career opportunities in Earth system science.

The institute will typically be offered in July, but interested persons should check the Web site for further information. The program will run in the summers of 2000, 2001, and 2002, and is limited each year to ten teachers and fifteen students from Maine, New Hampshire, or Vermont. High school teachers of Earth science, general science, or environmental science are especially encouraged to apply, but applications will be accepted from other disciplines. Students should be entering ninth or tenth grade. Participating teachers are expected to further test and refine curriculum in their classrooms during the school year. Course materials and room and board are provided. Participants also receive a $500 stipend upon successful completion of the institute.

CONTACT: Nancy Lightbody, College of Education and Human Development, University of Southern Maine, 328 Bailey Hall, Gorham, ME 04038; Phone: (207) 228-8115; Fax: (207) 780-5224; Email: nancy@lightbody.org

Boreal Forest Watch

Boreal Forest Watch (BFW) is an educational outreach program for the Boreal Ecosystem Atmosphere Study (BOREAS). BFW involves 9–12 graders in conducting real research as part of their educational experience. Teachers and students practice the scientific method by participating in an on-going research project. They are able to integrate multidisciplinary skills in a problem-solving approach. All activities within the program meet or exceed provincial educational standards in science, mathematics, and other fields.

BFW takes place in the boreal ecosystem region of northern Saskatchewan and Manitoba, Canada. Students and teachers from several area schools near Prince Albert, SK and Thompson, MB conduct environmental monitoring studies in the boreal forests near their schools. Students set up permanent sampling plots and assess the current condition of this plot. They also collect data such as tree height, diameter, overstory and understory species composition, tree core analysis, land cover mapping and remote-sensing activities, and plant anatomical characteristics among many other measurements and activities. These data are collected and archived for future use in ecological monitoring studies of the boreal region as well as in class studies.

Teachers are trained on how to conduct program activities, which includes introduction and training in remote-sensing principles. Intensive BFW training workshops are held periodically in the Prince Albert area.

CONTACT: Shannon Spencer, Complex of Earth, Oceans, and Space, Morse Hall, University of New Hampshire, Durham, NH 03824; Phone: (603) 862-1792; Fax: (603) 862-0188; Email: shannon.spencer@unh.edu
or—Bradley Muir, Prince Albert National Park, Waskesiu Lake, Saskatchewan, CANADA, S0J 2Y0; Phone: (306) 663-5322; Fax: (306) 663-5424; Email: b.muir@sk.sympatico.ca

Certificate and Master's Degree Program in Earth/Space Science for Elementary/Secondary Teachers

http://henry.pha.jhu.edu/ssip/index.html

The Maryland Space Grant Consortium, in collaboration with The John Hopkins Graduate Division of Education, has integrated nine graduate credits, earned by teachers who complete the three phases of the Consortium's Space Science Internship Program for Elementary and Secondary teachers (SSIP), into six core courses that comprise both a Johns Hopkins Graduate Certificate Program and a Master's Degree Program in Math and Science Education with a specialization in Earth/space science. These three graduate programs enable teachers to: 1) obtain a Master's of Science degree with a specialization in Earth/space science; and 2) obtain credits to meet state certification requirements in Earth/science. Teachers may also choose to use six credits attained from completing Phases I and II of SSIP toward Maryland State Department of Education, Continuing Professional Development credits.

SSIP promotes course content from NASA's Earth Science Enterprise to promote the Maryland School Performance and Assessment Program core learning goals for science, the American Association for the Advancement of Science K–12 Benchmarks for Science Library, and the National Academy of Sciences' K–13 Standards.

SSIP includes three Johns Hopkins courses—"Understanding and Teaching the Solar System" (PHASE I), "Understanding and Teaching Earth Observation from Space" (PHASE II), and an eight-week research internship (PHASE III). This graduate degree program for in-service teachers fosters collaboration among The Johns Hopkins Graduate Division of Education, NASA Goddard Space Flight Centers' Education Office, the Maryland State Department of Education, and affiliates of Maryland Space Grant Consortium.

CONTACT: Anne Anikis, Assistant Director, Maryland Space Grant Consortium, The Johns Hopkins University, Bloomberg Center for Physics and Astronomy, Room 203 , 3400 N. Charles Street, Baltimore, MD 21218-2686; Phone: (410) 516-7106; Fax: (410) 516-4109; Email: anne@pha.jhu.edu

Concepts and Pedagogical Strategies in Earth System Science Education for K–7 Teachers

This summer workshop at West Chester University of Pennsylvania is designed for pre-service and in-service K–7 teachers to enhance their understandings about Earth system science, develop abilities in Earth system science education (ESSE), and develop an ESSE Action Plan for their grade level.

Participants will explore key questions related to Earth system science, use state-of-the-art technologies to observe and study the Earth system in real time, and learn ways to construct and utilize real-time satellite images for ESSE lessons. They will receive and practice using NASA teaching materials designed for Earth system science education, learn how to access NASA education materials, and revise the materials as constructivist inquiry-based ESSE lessons. By the end of the workshop, each participant will complete an ESSE action plan for their grade level using workshop materials, concepts, skills, and pedagogical strategies.

The workshop meets Wednesdays from June 30 through July 28. There are also several one-day field trips, including a visit to the NASA Educator Resource Center at Goddard Space Flight Center. Participants can receive one undergraduate credit or one Continuing Education Credit for the workshop (cost waived by West Chester University).

CONTACT: Richard M. Busch, Department of Geology & Astronomy, West Chester University, West Chester, PA 19383 USA; Phone: (610) 436-2716; Fax: (610) 436-3036; Email: rbusch@wcupa.edu

Consortium for the Application of Space Data to Education (CASDE)

A wide variety of training opportunities for pre-service and in-service teachers are available through the ***Consortium for the Application of Space Data to Education (CASDE).*** This consortium was created to provide mechanisms to integrate NASA's extensive data holdings and advanced information system technologies into education. CASDE is dedicated to providing the educational community with vast amounts of NASA imagery, tools, educational resources, and interdisciplinary activities. CASDE tools, tutorials, a useful "building-block" curriculum structure, classroom ready posters, and interactive laboratory kits, have all been developed by the consortium to introduce the basics of interpreting space imagery and incorporating potential applications of NASA data to the education community and other interested parties.

The leadership of CASDE comes from three organizations, including the University of Nebraska at Lincoln, Center for Advanced Land Management Information Technologies, the Jet Propulsion Laboratory, and the University of Nebraska at Omaha Office of Internet Studies. Through these three organizations, the CASDE staff offers a variety of periodic staff development opportunities for educators (both pre-service and in-service) and other professionals (such as resource managers), who are interested in gaining more information or training-related CASDE resources. For example, one-day introductory seminars are available that introduce participants to CASDE imagery resources, sample curriculum activities, and software. Weeklong workshops are also offered periodically to provide teachers and other professionals a more in-depth training in CASDE resources, image visualization tools, and lesson design. The workshops also assist teachers in developing curriculum specific to their classrooms. In addition to these shorter duration opportunities, several graduate courses, and extended independent study classes for graduate credit, are also available from the University of Nebraska at Omaha. Web-based training opportunities, called "Webshops" are also being developed by the consortium. Within all the training opportunities, educators are involved in a wide variety of "hands-on" activities to help support a strong base of CASDE resource awareness, experience, and classroom integration. Participants particularly gain valuable experience with new technology-based tools, such as DataSlate, which is a new technology that allows users to explore essentially infinite data sets and to simultaneously compare co-registered and geo-referenced sets of data. DataSlate is being developed by the Jet Propulsion Laboratory.

CASDE invites partnering with other organizations to help provide such teacher training opportunities in various locations, and actively seeks collaboration with teachers and other professionals who are interested in expanding CASDE curriculum efforts.

CONTACTS: Paul Clark, Office of Internet Studies, UNO, Omaha, NE, 68182-0163; Email: Paul_Clark@unomaha.edu

Rick Perk, University of Nebraska, Lincoln, 113 Nebraska Hall, Lincoln, NE 68588-0517; Email: rperk@tan.unl.edu.

The Dynamic Earth

http://www.discoverycube.org

Discovery Science Center is an interactive science center with over 100 hands-on exhibits augmented by educational programming and materials providing learning opportunities for students, teachers, and family audiences. ***The Dynamic Earth*** program includes:

- Resource materials and kits provide the classroom teachers with a set of

hands-on materials that will enable the students to design and test experiments. The curriculum packet contains science content information, vocabulary list, a materials list, timeline for preparation and implementation, tips for managing the students or classroom during hands-on experiences, a bibliography of additional materials, and a collection of professional contacts.

- Teacher training program in the use of these materials and lesson plans. This six-hour training, along with the teacher's guide and kit will enable two to three weeks of classroom instruction.
- An interactive science presentation for the classroom or general public.
- Family science nights at the science center. These evenings will introduce families to the science programs presented in the schools. Families will observe science demonstrations, attend science lectures, interact with the hands-on exhibitry, such as an earthquake simulation room, an eight-foot free-standing tornado, and a kalliroscope that models the fluid dynamics of the ocean and/or the atmosphere.

Some of the concepts the participants in The Dynamic Earth program will investigate are:

- Plate tectonics and the changing patterns of land, sea and mountains on the Earth's surface;
- How the sun's heating of the Earth's surface drives convection within the atmosphere and oceans, producing winds and ocean currents, leading to an understanding of global weather patterns and geographical distribution of marine and terrestrial organisms; and
- Human impact on the Earth's atmosphere, and in turn how the altered atmospheric conditions affect all life on Earth.

Interested parties should contact the Education Department or Group Bookings at (714) 542-2823.

CONTACT: Janet Yamaguchi, Vice President, Education, Discovery Science Center, 2500 North Main Street, Santa Ana, CA 92705; Phone: (714) 542-2823; Fax: (714) 542-2828; Email: jyamaguchi@discoverycube.org

Earth Science Component for Academic Professional Enhancement (ESCAPE)

http://www.ssec.wisc.edu/outreach/escape

Professional development opportunities in the Earth and space related sciences continue to be the area of greatest need for teachers in Wisconsin. This project is addressing the Earth system science professional development needs of upper elementary, middle and high school science teachers in Wisconsin and interested neighboring states by offering NASA's Classroom of the Future (COTF) online Earth system science course in conjunction with the GET-WISE project.

Through our existing distance learning project, GET-WISE (Geoscience Enhancement for Teachers—Wisconsin Initiative for Space Education), and in partnership with the Wisconsin Academy Staff Development Initiative (WASDI), we will recruit teachers from around the state to participate in the online Earth system science course. This program will be facilitated by scientists/education specialists.

Project GET-WISE was developed to exploit the use of instructional technology to achieve two critical objectives. First to link teachers across Wisconsin through the use of distance learning tools. Second, to support teachers integrating current instructional technologies in the development of improved Earth system science curriculum that is hands-on, motivating, engaging and effective in addressing the Wisconsin State Science and Technology standards. The University of Wisconsin School of Education, will offer two graduate credits for each semester of participation in the GET-WISE Initiative and additional credit will be offered for participation in follow-up summer workshops to be conducted by WASDI at one of thirteen sites around the state.

CONTACT: Rosalyn A. Pertzborn, Research and Outreach Specialist, Office of Space Science Education—Space Science & Engineering Center, University of Wisconsin-Madison, 1225 W. Dayton Street, Madison, WI 53706; Phone: (608) 265-4160; Fax: (608) 262-5974

Earth Science Enterprise Research Program—University of Montana

The University of Montana (UM) provides a technology learning center for professional teacher training and teacher in-service, which brings remote-sensing and basic Geographic Information System (GIS) applications into the classroom. Using data products provided by UM's Numerical Terradynamic Simulation Group (NTSG) and supplementing ongoing educational programs, UM's learning center introduces the latest remote-sensing concepts to the next generation of science classrooms in Montana.

UM has developed an online, for credit, course program for pre-service and in-service education of the teachers of Montana, as well as the technical components to expand this program nationally and internationally. This project brings online Earth system science courses developed by the Center for Educational Technologies at Wheeling Jesuit University into the UM learning environment, presented through the e-College™ network.

Additionally, the project plans outreach and study of online courses for the Montana Native American population, working closely with several reservations across Montana. During the first year, the project will focus on one reservation and then expand over the three-year program to integrate operations in state and national hosts. Immediate impact is expected on Montana classrooms, with plans to explore the impact on Native American classrooms where special conditions and constraints may prevail. Project evaluation will delve deeply into the perceived meaning of scientific understandings in the Native American teaching corps and examine how these meanings are communicated in their classrooms.

CONTACT: John Kuglin, Director of Educational Outreach, or Wes Snyder, Research Professor of Education, University of MT, James E. Todd Building, Missoula, Montana 58912; Phone: (406) 243-6334; Fax: (406) 243-2047; Email: jkuglin@selway.umt.edu

Earth System Science Academy

http://nia.ecsu.edu/nrts/ess/earth.html

The Network Resources and Training Site is funded by the MU-SPIN Office of Goddard Space Flight Center. The Network Resources and Training Site (NRTS) housed at Elizabeth City State University is designed to serve the states of North Carolina and Virginia. The NRTS provides technology training and facilitate HBCU/MI network opportunities in research and education for science/mathematics faculty and students, as well as for the teachers of predominately minority-attended elementary and secondary schools in ECSU's region. Research focus for this NRTS include high performance networks and Earth system science.

The Earth System Science Academy is one of the major K–12 Earth system science initiatives sponsored by the NASA NRTS. During the two-day summer academy, teachers tour the Great Dismal Swamp and actively become involved with water testing techniques. Teachers attended both Geoscience and Computer Science workshops. Internet workshops focus on NASA educational resources on Earth system science. The Earth System Science Academy offers educators the opportunity to learn about the health of local waterways and the Great Dismal Swamp. The Academy challenges educators to develop new skills through the experience of working with university and NASA researchers. Included in the Earth System Science Academy is a tour of the Great Dismal Swamp Boardwalk; Hands on Water Quality Labs; and workshops on Earth system science.

CONTACT: Dr. Linda Hayden, NASA Network Resources and Training Site, Elizabeth City State University, Box 672, 1704 Weeksville Road, Elizabeth City, NC 27909; Phone: (252) 335-3696; Fax: (252) 335-3790; Email: lhayden@umfort.cs.ecsu.edu

Earth System Science Education Alliance (ESSEA)

http://www.cet.edu/essea

The Earth System Science Education Alliance (ESSEA), a partnership between the Institute for Global Environmental Strategies (IGES), the Center for Educational Technologies (CET) at Wheeling Jesuit University, through funding from NASA's Earth Science Enterprise, is an exciting and innovative professional development program.

ESSEA will support universities, colleges, and science education organizations in offering K–12 Earth system science (ESS) online graduate courses that have been developed within the CET at Wheeling Jesuit University for NASA's Earth Science Enterprise. The Earth system science courses use an innovative instructional design model, are delivered over the Internet, and feature student-centered, knowledge-building virtual communities. Successful proposers will participate in an intensive four-day training workshop to learn how to deliver the courses.

The ESS courses feature student-centered, knowledge-building communities in which groups of teacher/participants engage in problem solving, model building, and classroom activity design. A master teacher and/or an Earth system scientist, who act as guides and mentors throughout the 16-week courses, moderate participants. Participants' expectations are set through the use of rubrics for individual and group work as they learn new ESS content, become knowledgeable about new resources, develop confidence in the use of technology, and design new classroom activities.

IGES will award three-year grants to entities with unique and innovative proposals to facilitate and offer the Earth system science online courses developed and tested by CET. Plans are to issue new grants in early 2000, late 2000, and in 2001. A copy of the full proposal and guidelines is available at the ESSEA Web site—**http://www.cet.edu/essea**—or by mail at the address below.

CONTACT: Claudia Dauksys, ESSEA Program Associate, Institute for Global Environmental Strategies, 2111 Wilson Blvd., Suite 700, Arlington, VA 22201; Phone: (703) 875-8634; Fax: (703) 875-8635; Email: essea@strategies.org

Earth System Science Online Course: An Opportunity in Geography Education

http://www2.una.edu/geography

The goal of this project is to offer K-12 teachers of geography, Earth science, social studies and other related subjects the opportunity to increase their content knowledge in the field of Earth system science in a convenient, technology-enhanced environment. The objectives are to:

- Increase K-12 teachers' knowledge of, and experience in, Earth system science;
- Provide teachers in underserved areas of Alabama, the southeast and other areas an opportunity to take a graduate level class in Earth system science;
- Enhance K-12 teachers' use of the Web and source material available through various governmental, private industry and educational organizations;
- Offer pre-service education students the opportunity to increase their content knowledge in Earth system science, while trying a new delivery method; and
- Test and demonstrate the power of the Internet and World Wide Web as a complete delivery system mechanism for Earth system science instruction.

Admittance to the graduate program at the University of North Alabama is a requirement of participation. It is anticipated that the course will be offered starting with the fall semester 2000.

In addition to delivering the existing Earth system science online course that has been developed by the Center for Educational Technologies at Wheeling Jesuit University, the course will bring an additional focus on the use of the Essential Elements of the National Geography Standards.

CONTACT: Dr. William R. Strong, Box 5064, Department of Geography, University of North Alabama, Florence, AL 35632-0001; Phone: (256) 765-4218; Fax: (256) 765-4911; Email: wstrong@unanov.una.edu

Earthworks: Earth System Science for Secondary Teachers

This one-week workshop provides an opportunity for teachers to investigate Earth system science, the interaction between Earth, atmosphere, oceans, life forms, and space. Participants will work with scientists and each other to develop their understanding and appreciation of the Earth. This workshop is designed for pre-service and new in-service teachers, who are interested or involved in teaching secondary science. It will be held in the mountains above Boulder, Colorado during the summer of 2000.

This workshop is guided by the philosophy that students learn through active involvement with real life experience, and that teachers should provide students with rich learning experiences that will allow them to explore Earth system science. Recognizing that teachers often teach in the same way in which they were taught, our aim is to provide a learning experience for educators that models sound educational practice.

The goals of this interactive, process-oriented workshop are to provide teachers with a self-directed learning experience in which they can develop an understanding of Earth systems and share that understanding with others; and to foster an ongoing community, including teachers and scientists, that will be maintained throughout the school year.

Cost to participants will be minimal (most expenses will be covered, including child care), however, those with high transportation expenses may need to find additional sources of funding.

CONTACT: Dr. Alex Weaver, CIRES, Campus Box 216, University of Colorado, Boulder, CO 80309; Phone: (303) 492-5431; Fax: (303) 492-1149; Email: alex.weaver@colorado.edu

Forest Watch

http://www.forestwatch.sr.unh.edu

Forest Watch is an environmental education program developed and run by Complex Systems Research Center at the University of New Hampshire (UNH). It is designed to introduce both teachers and their students to field, laboratory, and satellite data analysis methods for assessing the state-of-health of local forest stands. Forest Watch provides workshops which are designed to help K-12 teachers introduce their students to selected hands-on techniques for evaluating the health of white pine (Pinus strobus), a bio-indicator for tropospheric ozone damage. Students and teachers setup permanent sampling plots in a forest stand and conduct several ecological and biophysical measurements using scientific protocols.

In conducting ecological site assessments, students are introduced to several disciplines of science, such as botany, biology, chemistry and physics, as well as other non-scientific disciplines. Students participate in three types of activities in Forest Watch: 1) forest stand assessment, including the selection of white pine trees for study, 2) laboratory-based assessment of foliar damage symptoms for the selected trees, and 3) image processing/data analysis of Landsat Thematic Mapper (TM) data for the area around their school. The student field and laboratory measurements are sent to the University of New Hampshire, where they are analyzed and integrated into an on-going regional white pine study.

CONTACT: Dr. Barry Rock, Program Director, or Mr. Shannon Spencer, Program Coordinator, Complex System Research Center, Morse Hall, University of New Hampshire, Durham, NH 03824; Phone: (603) 862-1792; Fax: (603) 862-0188; Email: forestwatch@unh.edu

The Gaia Crossroads Project

http://www.bigelow.org/~gaia/menu.html

The Gaia Crossroads Project is an innovative program using satellite remote sensing in K–12 classrooms. This progressive program captures the interest of elementary students and sustains their interest through high school. Using the imagery provided, students are able to study and interpret satellite images of their local communities. After the initial focus on the local environment, the program expands to include images of a broader geographic coverage-the Gulf of Maine and the North Atlantic for studying oceanography, weather satellite images for studying meteorology, and images of tropical rain forests for studying global ecosystems. The project provides ongoing teacher training and technical support.

The Gaia Crossroads Project's future plans include conducting a three-year pilot project in Maine to demonstrate that students can produce an accurate land use/land cover map of their state that will prove of value to state government. Another future plan is for a two-year pilot program to develop a new approach to a comprehensive study of the water cycle. Students and teachers will use NASA data and other imaging products to follow a drop of water from the time it falls as rain until it once again becomes a raindrop. The protocols, training modules, and strategies developed in these pilots would become models for students and teachers in other states.

The Gaia Crossroads Project Teachers Guidebook for Using Satellite Imagery in the Classroom and Community is available through Bigelow Laboratory. It contains background information on the project, a remote-sensing primer, hands-on tutorials, ideas for setting up the program in a classroom, over sixty activities written and classroom tested by teachers in the Gaia Crossroads Project, and an extensive listing of resources.

CONTACT: Cynthia B. Erickson, Project Director, The Gaia Crossroads Project, Bigelow Laboratory for Ocean Sciences, P.O. Box 475, McKown Point, West Boothbay Harbor, ME 04575-0475; Phone: (207) 633-9600; Fax: (207) 633-9641; Email: gaiaxroads@bigelow.org

Global Learning and Observations to Benefit the Environment (GLOBE)

http://www.globe.gov

GLOBE is a worldwide network of K–12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near their schools and report their data via the Internet. GLOBE environmental measurements are in the following study areas: Atmosphere, Hydrology, Land Cover, Soils, Global Positioning System (GPS), and Seasons. Scientists use GLOBE data in their research and provide feedback to the students to enrich their science education. Each day, images created from the GLOBE student data sets are posted on the World Wide Web, allowing students and visitors to the GLOBE Web site to visualize the student environmental observations. Teachers and students from over 6,500 schools in over 80 countries participate in GLOBE.

An interagency team manages GLOBE, which includes NASA, the National Oceanic and Atmospheric Administration, the National Science Foundation, the Environmental Protection Agency, and the Departments of Education and State.

There is no cost to participate in the GLOBE Program. However, schools must support participation by one or more teachers to attend a GLOBE Training Workshop and make equipment available to students for taking measurements and Internet access for reporting their data.

CONTACT: GLOBE Program, 744 Jackson Place, Washington, DC 20503; Phone: (800) 858-9947; Email: info@globe.gov

Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)

http://icp.giss.nasa.gov

ICP's mission is to contribute an innovative model for teaching and learning science that connects NASA's climate system research to national science standards and foster the professional/academic advancement of minority students in the sciences. The ICP is conducted in collaboration with the City University of New York (CUNY), Columbia University, New York City Public Schools, and Science Systems and Applications, Inc.

Student Research Interns and Faculty Fellows are competitively selected from New York City area pre-college and college institutions and given tangible roles on GISS research teams organized to advance our understanding of climate forcings and natural variability that produce climate change. Activities during Summer Insti-tutes (six–eight weeks) and an Academic Year Program (GISS- and school-based) are designed to facilitate research projects and develop relevant science skills and content understandings. Annually, student researchers at GISS and/or ICP schools make presentations at science fairs, regional and national science competitions and the ICP Spring and Summer Conferences. ICP students view research experiences as a means to their advancement in the science pipeline, with program alumni now entering highly competitive schools and job markets. Throughout the year, ICP faculty and GISS scientists collaborate to produce student projects and lessons, as well to share them at professional meetings and conferences.

With the support of NASA's Minority University-Space Interdisciplinary Network Resource Training Site at the City College of New York (CCNY), ICP schools are gaining the technical

competencies and resources needed to participate in an electronically connected research and education network.

An Earth Climate Teacher Education Course and school-based Teacher Institutes are the newest components under development. The context for the course and institutes is to examine the Earth's climate as an evolving, dynamic system by investigating how the input solar radiation interacts with the system characteristics to produce the output climate conditions. Partnerships with Columbia University, CUNY and New York City Urban Systemic Initiative are contributing to these teacher courses and institutes.

CONTACT: Carolyn Harris, NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025; Phone: (212) 678-5653; Fax: (212) 678-5552; Email: charris@giss.nasa.gov

Goddard Space Flight Center (GSFC) Teacher Intern Program

Local Maryland teachers are selected by application and work with scientists, mathematicians, computer technologists, and engineers for six weeks each summer. The teacher will learn about the scientist's project and will develop an educational component—past educational projects have included video animation and lab experiments. This internship is developed as a partnership, therefore the teacher and the scientist will determine their working relationship. Final selection is determined by an interview with the scientist. Eligible participants are local certified teachers, who have been teaching for a minimum of two years, and have competent computer skills. Applications are due in late February each year to the Prince George's County Public School Science Office, attention James Strandquist. Approximately ten teachers are selected for the summer internship; many are placed with GSFC's Earth Science Directorate.

CONTACTS: Elaine Lewis, Goddard Space Flight Center, Code 130.3, Greenbelt, MD 20771; Phone: (301) 286-7356; Fax: (301) 286-1707; Email: elewis@pop100.gsfc.nasa.gov

James Strandquist, Supervisor of Science, Prince George's County Public School Science Office, 9201 East Hampton Drive, Capital Heights, MD 20743; Phone: (301) 808-8251

Interactions and Diversity: Earth System Science and Beyond

http://ismul.upr.clu.edu
http://web.uprr.pr/prsgc

With demographic trends targeting Hispanics as the fastest-growing and largest minority, it is vital to strengthen efforts to attract them to science-related fields, to help Hispanics reach appropriate representation in the Nation's education base. The Integrated Science Multiuse Laboratory (ISMuL) at the University of Puerto Rico Arecibo Campus, an affiliate of the Puerto Rico Space Grant Consortium, seeks to attract Hispanic students to careers in Science, Mathematics, Engineering and Technology (SMET) by strengthening the capabilities of their science and mathematics teachers.

ISMuL brought together key local and national experts to develop an experimental educational model responsive to needs in the areas of Earth system science, while helping both PR and US teachers to explore together teaching methodologies reflective of the growing ethnic diversity in the Nation. The goal was to promote a better understanding of the idiosyncrasies and cultural aspects that affect the education of under-represented Hispanics by promoting teachers' awareness of cultural and ethnic diversity issues and knowledge of strategies for the productive management of this diversity in the classroom.

As a result, a 10-day summer program equivalent to three credit-hours, on the Earth's interconnections in Tropical Environment focusing in active NASA-sponsored research carried out in the Island will be offered in the summer of 2000. The workshop will focus on the study of distinctive microenvironments in Puerto Rico and the Caribbean and their interactions with life. The underlying questions will be: how do land, water, air and life interact to produce the environment on which we live, and to a lesser extent, what is the effect of human activities in these interactions. Science and Math teachers from PR and US, particularly from areas that serve significant Hispanic populations, will be invited to participate and 26 will be selected on a competitive basis, in an approximate 1:1 ratio of PR and US participants. Participants will develop and pilot test curricular activities for the teaching of Earth system science and serve as resources for the dissemination of Earth system science education among their peers as well as in the pre-service teacher level.

CONTACT: Ibis L. Aponte-Avellanet, Associate Director, Puerto Rico Space Grant Consortium, Director ISMuL, PO Box 23334, San Juan, PR 00931-3334; Phone: (787) 765-5170, ext. 2117 or (787) 764-0000, ext. 5807; Fax: (787) 756-7717; Email: ibis@adam.uprr.pr

An Interdisciplinary Teacher Training Program on Earth System Science Using Information Technology

http://www.pitt.edu/~aap/announce.html

The University of Pittsburgh at Bradford is offering a one-week interdisciplinary summer workshop on Earth system science aimed at preparing pre-service education students and in-service teachers for the 21st Century. The objective of this

interdisciplinary teacher-training course is to develop in students an understanding of the Earth processes shaping the past, present, and future. The course provides hands-on training and experience in applied environmental problem-solving through field work, lab practicals, and space-based technology.

Annually, from 2000–2002, the university will solicit a group of 16 motivated, energetic pre-service and in-service science teachers who wish to grow professionally. The program is open at a national level to everyone qualified to apply. The major selection criterion is the potential for integration of the program materials into the participants' instructional activities. Minorities and women are strongly encouraged to apply, as well as those who teach Earth science to communities under-represented in science education. The 2000 workshop will be held July 9–14.

Teachers who are accepted into the program have their tuition and room and board underwritten by the NASA grant. Successful participants will be awarded one college credit for pre-service or 55 hours of continuing education credit/contact time for in-service participants.

The scientific team conducting this teacher-training program consists of seven faculty members from scientifically diverse backgrounds: one Pitt-Bradford geology and environmental scientist, a chemist from Pitt-Bradford, the Pitt-Bradford Director of Education Program, a research librarian from Pitt-Bradford, a biologist from Mercyhurst college, a Geographic Information System Specialist from Northern Illinois University, and a meteorologist from The Pennsylvania state University.

CONTACT: To apply, use the electronic application form at:
http://www.pitt.edu/~aap/announce.html
or contact: Dr. Assad Panah, Professor & Director, Department of Geology and Environmental Science, University of Pittsburgh at Bradford, 300 Campus Drive, Bradford, PA 16701; Phone: (814) 362-7569; Fax: (814) 362-5088; Email: aap+@pitt.edu

The JMU DEVELOP Center—Digital Earth

The Digital Earth is a virtual representation of our planet that enables a user to explore and interact with the vast amounts of natural, cultural, and historical information being gathered about the Earth. The Digital Earth initiative brings together Federal Agencies, private and not-for-profit institutions, and other contributors to facilitate the development of the technology, standards, and content necessary for realization of the Digital Earth

The JMU DEVELOP Center focuses on student-oriented research that blends course work and capstone experiences, faculty and student investigations, and industrial experiences. Towards that end, the JMU DEVELOP Center provides:

- Student and teacher access to interagency data;
- Inspiration of individuals to learn about the Earth through center activities;
- Promotion of Digital Earth technology on a local, state, regional, national, and international level;
- The "bridge" between public outreach and education, and Digital Earth technologies;
- Instructional videos and multimedia;
- Computer lab to complete educational activities;
- Virtual reality interfaces;
- NASA research and information; and
- Set of planned activities based on educational level.

JMU will offer a one-week digital Earth workshop for pre-service teachers and a small group of in-service teachers the third week of June 2000 at James Madison University.

CONTACT: James L. Barnes, James Madison University, Harrisonburg, VA 22807; Phone: (540) 568-3154; Fax: (540) 568-2747; Email: barnesjl@jmu.edu

Mission Possible: Earth System Science, the Curriculum, and You

This three-week interim course is intended to provide pre-service elementary and middle-school teachers with the opportunity to become familiar with the interdisciplinary field of Earth system science. The course will provide participants with hands-on training with NASA curriculum support materials and introduce them to national and local resources, with help from education specialists from the South Dakota Space Grant Consortium and NASA Johnson Space Center. Representatives from EROS Data Center (EDC) will provide educational materials and training on EDC resources. Participants will learn how to use the interactive multimedia technology resource—*The Voyage of the Mimi*—an integrated set of concepts that involve students in math, science, social studies, and language arts related to Earth system science. The opportunity to become proficient in the use of image processing in the classroom will also be provided. Eligible participants are pre-service elementary and middle-school students at Augustana College and other colleges in the South Dakota Space Grant Consortium participating in the interim course concept.

The cost of tuition is included in the annual tuition costs for each student—no extra costs are anticipated. Students from other colleges will pay room and board, however room and board is available for up to three visiting students.

CONTACT: Valerie Keeling Olness, Department of Biology, Augustana College, 2001 Summit Avenue, Sioux Falls, SD 57197; Phone: (605) 336-4720; Fax: (605) 336-4492; Email: olness@inst.Augie.edu

NASA Earth Science Education Products Workshops

The Institute for Global Environmental Strategies (IGES), through funding from NASA's Earth Science Enterprise, convenes an annual workshop for representatives from NASA Educator Resource Centers (ERCs), Aerospace Education Services Program (AESP), and Teaching from Space (TFS) Program.

Participants receive training in new NASA Earth science education products that they can distribute through their ongoing in-service teacher workshops. Participation in the annual workshop is limited to NASA ERC, AESP, and TFS representatives. These representatives then hold teacher workshops in their state, where the products are made available to teachers. Contact IGES for information on NASA educators in your state who are conducting Earth science workshops for K–12 teachers.

CONTACT: Stacey Rudolph, IGES, 2111 Wilson Blvd., Suite 700, Arlington, VA 22201; Phone: (703) 875-8634; Fax: (703) 875-8635; Email:stacey_rudolph@strategies.org

NASA RISE

http://www.cisat.jmu.edu/projects/nasa

NASA RISE of the College of Integrated Science and Technology at James Madison University offers a variety of pre-service and in-service workshops for students preparing to be science, mathematics and technology teachers and practicing teachers, supervisors, curriculum developers, and school administrators. These workshops focus on NASA Earth system science and related SMET content, implementation of national standards in science, mathematics, and technology, scientific visualization, instructional and information technology, remote sensing, and geographic informations science. Workshops will help teachers to:

- Learn through minds-on, hands-on modeling and demonstrating experiences, innovative instruction, content, technology and the use of technology in teaching with NASA Earth science curriculum materials, data, and information;
- Practice and replicate innovative instruction, content, educational technology and the use of technology in teaching with NASA Earth science curriculum materials, data, and information; and
- Learn how to develop innovative instruction that is based on the national standards and benchmarks for mathematics, science, and technology and involves the research and development areas of NASA's Earth Science Enterprise and other NASA resources.

CONTACT: James L. Barnes, Director, NASA RISE, College of Integrated Science and Technology, 701 Carrier Drive, MSC 4102, James Madison University, Harrisonburg, VA 22807; Phone: (540) 568-3154; Fax: (540) 568-2761; Email: barnesjl@jmu.edu

Pan American Center for Earth and Environmental Sciences (PACES)

http://www.geo.utep.edu

The University of Texas at El Paso (UTEP) is involved in several initiatives to improve science education within the El Paso area public schools. These include outreach efforts into the classrooms; training programs for in-service teachers; and the introduction of a strong pre-service Science Core Curriculum. This project combines the goals of these initiatives into a multi-year series of Earth system science workshops for pre-service and in-service teachers using NASA Earth Science Enterprise materials and materials developed specifically for this region through the *Pan American Center for Earth and Environmental Sciences (PACES)*, a NASA-funded University Research Center. Five workshops will present an Earth system science perspective using NASA and UTEP materials. Each workshop will focus on one aspect of Earth system science: an introductory workshop; the lithosphere; the biosphere; the atmosphere and hydrosphere; and astronomy. A sixth, and final, workshop will consist of a field trip to the NASA Regional Educator Resource Center maintained by the New Mexico Space Grant Consortium located at New Mexico State University in Las Cruces, New Mexico. The El Paso area satellite images processed by PACES and the lesson plans developed by the workshop participants will be available via the PACES Web site at UTEP.

The workshop is free; participants are selected competitively.

CONTACT: Vicki Harder, Principal Investigator, University of Texas at El Paso, El Paso, TX 79968; Phone: (915) 747-5746; Fax: (915) 747-5305; Email: vharder@geo.utep.edu
or—Sally Blake, Co-Investigator, University of Texas at El Paso, El Paso, TX 79968; Phone: (915) 747-7675; Fax: (915) 747-5305; Email: sblake@utep.edu

Planet Earth: A Science and Methods Course for Pre-Service and In-Service Teachers

http://k12s.phast.umass.edu/~nasa

The *Planet Earth* course will serve pre-service teachers and in-service teachers (grades four–nine). This program will be offered for the third and probably last time during summer 2000, from August 14–18, 2000.

Each day will focus on an important Earth system area: acid rain, global warming, the water cycle, oceans and climate, and planetary environments. The content sessions will employ student-active learning methods, and will be

integrated with Web based, hands-on, and field based activities. The day ends with an examination of related classroom issues such as the curriculum frameworks and assessment. Each participant will develop and implement a lesson plan or curriculum unit during the fall semester.

In-service teachers will participate in a fall semester program of classroom Earth systems research plus two Saturday workshops. They will be eligible for three graduate credits in Geosciences or Education or 42 "Professional Development Points." Pre-service teachers will attend academic year workshops devoted to additional science teaching methods. They will receive three credits for Education 462, Elementary Science Methods.

CONTACT: To register, contact Eugenie Harvey; Phone: (413) 545-1290; Email: eharvey@k12s.phast.umass.edu
Questions should be addressed to: Morton Sternheim; Phone: (413) 545-1908; Email: mort@k12s.phast.umass.edu

PUMAS (Practical Uses of Math And Science)

http://pumas.jpl.nasa.gov

PUMAS is an online journal of brief examples illustrating how math and science concepts taught in pre-college classes are actually used in everyday life. PUMAS offers a way for researchers to make a substantial contribution to education with a relatively small investment of time and effort.

PUMAS examples may be activities, anecdotes, descriptions of "neat ideas," formal exercises, puzzles, or demonstrations, written primarily by scientists, in any style that serves the material well. They are intended mainly to help K–12 teachers enrich their presentation of science and math in the classroom. The PUMASWeb site provides wide distribution; the site receives over 3,000 hits per week, on average.

Teachers can search the PUMAS collection based on curriculum topic, grade level, or subject. They can select relevant examples, and develop ideas of their own about how to integrate the material into their lesson plans.

All examples are peer-reviewed by at least one scientist with a relevant background, and at least one teacher at an appropriate grade level. Once accepted, an example is a citable reference in a refereed science education journal, and may be listed in your resume.

Interested in participating? The examples are available to everyone via the PUMASWeb site. The project also needs teachers at all grade levels, scientists, and engineers to volunteer for the pool of PUMAS reviewers. And the project is always looking for good examples of the Practical Uses of Math And Science.

CONTACT: Ralph Kahn, editor and founder, Jet Propulsion Laboratory, MS 169-237, 4800 Oak Grove Drive, Pasadena, CA 91109 USA; Phone: (818) 354-9024; Fax: (818) 393-4619; Email: ralph.kahn@jpl.nasa.gov

University of Montana's Earth Observing System (EOS) Education Project

http://www.eoscenter.com

This project disseminates EOS mission imagery, supportive curriculum, and relevant programs to the K–16 education community. *The EOS Education Project* also provides training for the K–16 educational community in the interpretation, utilization, and relevancy of EOS mission imagery. These resources are delivered through a dynamic combination of online and onsite teacher workshops, Internet-based courses, national conferences, interactive map and image servers, and Earth system science content.

Distributed and classroom-based Geographic Information Systems (GIS) are used to assist teachers to obtain remote-sensing imagery and ancillary data for project-based learning. We investigate how EOS information can enhance existing NASA interdisciplinary curriculums that explore the diverse and changing landscapes of the world.

The EOS Education Project has assembled a team of education, technology, and resource specialists to serve the growing needs of the global environmental education community. The project has also established strategic alliances within the private and public sectors to advance state-of-the-art solutions for geographical information dissemination and education program development across local, regional, and global scales. The collective mission supports educator and student understanding of complex global ecosystems and humans' role in affecting these systems.

CONTACT: Phone: 1-800-0411-0341; Email: umtonline@selway[illegible]nt.edu

UNDERGRADUATE & GRADUATE

Earth System Science Education Alliance (ESSEA)

http://www.cet.edu/essea

The Earth System Science Education Alliance (ESSEA), a partnership between the Institute for Global Environmental Strategies (IGES), the Center for Educational Technologies (CET) at Wheeling Jesuit University, through funding from NASA's Earth Science Enterprise, is an exciting and innovative professional development program.

ESSEA will support universities, colleges, and science education organizations in offering K–12 Earth system science (ESS) online graduate courses that have been developed within the CET at Wheeling Jesuit University for NASA's

Earth Science Enterprise. The Earth system science courses use an innovative instructional design model, are delivered over the Internet, and feature student-centered, knowledge-building virtual communities. Successful proposers will participate in an intensive four-day training workshop to learn how to deliver the courses.

The ESS courses feature student-centered, knowledge-building communities in which groups of teacher/participants engage in problem solving, model building, and classroom activity design. A master teacher and/or an Earth system scientist, who act as guides and mentors throughout the 16-week courses, moderate participants. Participants' expectations are set through the use of rubrics for individual and group work as they learn new ESS content, become knowledgeable about new resources, develop confidence in the use of technology, and design new classroom activities.

IGES will award three-year grants to entities with unique and innovative proposals to facilitate and offer the Earth system science online courses developed and tested by CET. Plans are to issue new grants in early 2000, late 2000, and in 2001. A copy of the full proposal and guidelines is available at the ESSEA Web site—**http://www.cet.edu/essea**—or by mail at the address below.

CONTACT: Claudia Dauksys, ESSEA Program Associate, Institute for Global Environmental Strategies, 2111 Wilson Blvd., Suite 700, Arlington, VA 22201; Phone: (703) 875-8634; Fax: (703) 875-8635; Email: essea@strategies.org

Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)

http://icp.giss.nasa.gov

ICP's mission is to contribute an innovative model for teaching and learning science that connects NASA's climate system research to national science standards and foster the professional/academic advancement of minority students in the sciences. The ICP is conducted in collaboration with the City University of New York (CUNY), Columbia University, New York City Public Schools, and Science Systems and Applications, Inc.

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Phone: (212) 678-5653;
Fax: (212) 678-5552;
Email: charris@giss.nasa.gov

NASA/ASEE Summer Faculty Fellowship Program

http://www.asee.org/fellowship/html/nasa.htm

NASA's Education Division, Higher Education Branch, in cooperation with the American Society for Engineering Education (ASEE), awards approximately 150 first-year summer fellowships to engineering and science educators. The ***Summer Faculty Fellowship Program*** is designed to further the professional knowledge of engineering and science faculty and NASA scientists and engineers, and contribute to the ongoing research at NASA facilities. The program provides an excellent opportunity for faculty to establish contacts with NASA researchers and generally learn more about to access the agency's resources.

Those selected for participation will receive a weekly stipend of $1,000, plus travel expenses, and a relocation allowance. Fellows spend ten weeks working at a NASA Field Center on a research project designed in collaboration with a NASA sponsor. Their working experience is supplemented with enrichment activities such as short courses, workshops, and seminars. Participating faculty members must be U.S. citizens with teaching or research appointments in a U.S. university or college, and have two years experience. Complete program information, including application forms, descriptions of the various research opportunities, and contact information

for each of the participating centers is available online at **http://www.asee.org/fellowship/html/nasa.htm.** The application deadline is February 1 and appointments are in March.

CONTACT: American Society for Engineering Education (ASEE), 1818 N Street, NW, Suite 600; Washington, DC 20036; Phone: (202) 331-3525; Email: projects@asee.org

NOVA

http://www.eng.ua.edu/~nova

NOVA was created to develop and disseminate a national framework for enhancing science, mathematics, and technology literacy for teachers in the 21st century. The NOVA consortium, with the University of Alabama, Fayetteville State University and the University of Idaho as lead institutions, is working to produce enhanced science, mathematics and technology literacy for new teachers. This effort is accomplished through the demonstration of an undergraduate science/math/technology course framework, examples of successful course models, and a mentoring support system for faculty wishing to implement new courses or modify existing courses at their universities. The framework uses interactive learning and integrates science, mathematics and technology as a means of developing a new paradigm for educating teachers. NOVA invites the participation of science, mathematics, engineering, technology, and education faculty who are concerned with how universities prepare new teachers. Using the NASA mission, facilities, and resources, NOVA provides faculty with enhanced knowledge and skills to implement change in university courses. The NOVA team presents its framework for change primarily through three-day workshops to interdisciplinary university teams. These universities are then eligible to submit proposals for Implementation Planning Grants (up to $30,000 for a one-year period) to initiate change in science, mathematics, or engineering courses for preparing K–12 teachers. In addition, the project links participants together through a World Wide Web server, which provides the means for faculty and students to exchange and have access to the model, materials, activities, and updated information.

The schedule of workshops and application information is available at **http://www.eng.ua.edu/~nova.** Each participating university or college must identify an interdisciplinary faculty team for the workshop. One team member must be a faculty member in the College of Education. A second team member must be a faculty member in science, mathematics, engineering, or technology. The third team member should be a university or college administrator (e.g., provost, dean, or department head). Applying teams must have access to interactive technologies and the Internet for classroom use. A memorandum of understanding signed by the deans of each college or division participating in the project must be submitted to demonstrate a university-wide commitment.

CONTACT: L. Michael Freeman, Aerospace Engineering & Mechanics, University of Alabama, Box 870280, Tuscaloosa, AL 35487-0280; Phone: (205) 348-7304; Fax: (205) 348-4171; Email: nova@coe.eng.ua.edu or mfreeman@coe.eng.ua.edu

University of Montana's Earth Observing System (EOS) Education Project

http://www.eoscenter.com

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CONTACT: Phone: 1-800-0411-0341; Email: umtonline@selway.umt.edu

SUPPORT FOR SYSTEMIC CHANGE

NASA's Earth science education program supports the development of systemic change initiatives that incorporate Earth system science into the state and local education systems at precollege and university levels.

ELEMENTARY & SECONDARY

Global Change Education—The New Jersey Initiative

The New Jersey Initiative for Global Change Education has been organized under the banner of Project ADD: Assemble, Develop, and Disseminate. These three elements should be understood as a system, the parts of which will support each other in the manner of positive feedback loops.

- The Assemble element of the plan refers to the gathering and organizing of existing global change resources, both human and material. These resources will be used in training activities and the materials will be housed at a central facility, the Center for Earth Science at Kean University, where they will be available to all interested educators.
- The Develop element has a two-fold purpose. One is to develop a network of people who have received training in global change education and who can then train others. To support this and other initiatives a global change education center will be organized to serve as a focal point for the dissemination of materials and information.
- The Dissemination effort is a key component and will take a variety of forms including workshops, short courses, a Web home page, and museum exhibits.

Change is a basic characteristic of the Earth system and operates across a variety of spatial and temporal scales. Understanding the Earth system and the changes that characterize it should become an important focus for education at all levels and the interdisciplinary aspects of global change should receive emphasis.

To accomplish these goals a New Jersey Council for Global Change Education has been established.

CONTACT: Paul Rockman, Kean University of New Jersey, Morris Avenue, Union, NJ 07083; Phone: (908) 527-2894; Fax (908) 629-7011;
Email: prockman@turbo.kean.edu

Maryland Earth and Space Systems Science Curriculum Project

NASA's Goddard Space Flight Center Education Office is collaborating with two Maryland school systems, Anne Arundel County Public Schools and Montgomery County Public Schools, to develop a new high school Earth and Space Systems Science curriculum. This curriculum will address the National Science Education Standards and Maryland's "Core Learning Goals"—**http://mdk12.org/mspp/high_school/what_will/science/index.html**—which will provide the basis for high school performance tests. The curriculum will use a systems approach and be grounded in current Earth and Space System Science content. Two courses are being developed: 1) a course for students

in grades nine or ten (with Algebra 1 as a pre-/co-requisite) and 2) a course for students in grades eleven and twelve (with Algebra 2 as a pre-/co-requisite).

The writing team is using information provided by NASA scientists as a basis for the content. The "five E" format, from Constructivist Learning Theory—**http://www.exploratorium.edu/IFI/resources/constructivistlearning.html**—is providing the skeleton for the curriculum design. Throughout curriculum development, Goddard's scientists will be consulted by the writing team to ensure that the science is correct and that the latest scientific facts, theories, and processes are incorporated into the curriculum. An advisory board will be identified to review the curriculum writing efforts.

Initial implementation of the first level of the course is planned for September, 2000 with revisions to the first course and development of the second level course planned for the 2000/2001 school year. Goddard will provide a Web site for curriculum dissemination so that the curriculum will be made available to other school systems.

CONTACT: John Entwistle, Goddard Space Flight Center, Code 130.3, Building 28, Room N167A, Greenbelt, MD 20771; Email: jentwist@pop100.gsfc.nasa.gov

NASA Earth Science Education Products Workshops

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CONTACT: Stacey Rudolph, Institute for Global Environmental Strategies, 2111 Wilson Blvd., Suite 700, Arlington, VA 22201; Phone: (703) 875-8634; Fax: (703) 875-8635; Email:stacey_rudolph@strategies.org

NASA Goddard Space Flight Center Earth System Science Education Project (GESSEP)—Maryland School System Grants and Regional Earth Science Activities

As an extension to the Maryland Ambassador Program, *GESSEP* teacher ambassadors are deeply involved in enhancing Earth and Space science instruction in their local systems and throughout Maryland. Professional development and curriculum planning workshops are supported through grants under this program. Examples of activities supported by this program include:

- A workshop was held at Easton High School, and involved 50 Earth Science Teachers in the nine Eastern Shore counties of Maryland. The workshop was related to the identification of support structures needed by schools and districts to implement the Core Learning Goals for High School Earth and Space Sciences.
- The Western Maryland counties of Allegany, Garrett, and Washington provided three days of staff development, planned and presented by Ambassadors, for all Earth and Space Science Teachers.
- Four teams of teachers from the five Southern Maryland Counties of Prince George's, Calvert, Charles, St. Mary's, and Anne Arundel completed their work, in early August 1998, to infuse technology into the Earth Science Curriculum developed by Baltimore County. The revised curriculum was to be piloted in the five involved counties during the 1998–1999 school year, with the piloted curriculum made available to all counties in the state.
- A GESSEP Ambassador and the Science Supervisor planned and conducted a two-day in-service for Earth science teachers in Calvert County.

Applicants are limited to participants from the Maryland Ambassador Program and selected on a competitive basis.

The Maryland Ambassador Program began in 1994, continuing through the end of the 1996 school year. Teams of Maryland middle and high school teachers participated in this four-week summer program, which was designed to enhance their teaching and help them serve as ambassadors to other teachers and to their local school district. Sixty-five teachers completed the Ambassador Program from across Maryland.

CONTACTS: Stephen Gilligan, Principal Investigator; Phone: (301) 375-8226

Vern Smith, Co-Investigator, GSFC, Code 130.9, Greenbelt, MD 20771; Phone: (301) 286-1977; Email: vern@aesp.nasa.okstate.edu

Project Earth Change (PEC)

http://www.uni.edu/ceee/eii

PEC is educating Iowans to take responsible action relative to global environmental changes. NASA funding, an NSF planning grant, Iowa Regents Eisenhower grants, Iowa REAP grants, University of Iowa CGRER grants, and a 4-H grant support the following components of the PEC program:

- **K–12 Formal Education**
  Instructional programs which enhance teachers' skills and resources to guide students through an understanding of issues, content background (science, mathematics, geography, language arts), and responsible environmental action. (e.g. Exploring Climate Change, 96–98; Weather, Climate, and Me, 98–99; Feeding the World in a Changing Climate, 99–2000)
- **Informal Education**
  Two units, having the structure necessary for informal instruction, have been developed to guide youth to understand issues, background (science, mathematics, geography), and responsible environmental action. *The Three Little Pigs Explore Climate Change*, and *Goldilocks and the Three Bears Explore Climate Change* are available from 4-H for instruction of upper elementary and middle school age youth.
- **Communication**
  An Internet system for communication among directors, teachers trained as school and district leaders, teacher workshop participants, students, and research scientists has been initiated.
- **Planning**
  Using data from current activities and formal student evaluation, PEC's steering and planning committees will continue the process of statewide implementation. PEC is a model for integration of science, mathematics, geography, language arts and other disciplines as a vehicle for global climate change education.

CONTACT: Carl W. Bollwinkel, Center for Energy and Environmental Education, University of Northern Iowa, Cedar Falls, IA 50614-0293; Phone (319) 273-2783; Fax: (319) 273-7140; Email: bollwinkel@uni.edu

UNDERGRADUATE

National Workforce Development Education and Training Initiative

Building a strong work force to populate one of the fastest growing industries in the nation is one of the challenges facing NASA's Commercial Remote Sensing Program (CRSP) at Stennis Space Center. On October 1, 1999, CRSP, along with NASA's Education and University Affairs Office at Stennis, announced a national program that is designed to meet that challenge.

The national plan is based on the successful approach demonstrated by the Mississippi Model for ***Workforce Development Education and Training*** (WDET), currently being implemented by CRSP's Mississippi Space Commerce Initiative. As NASA's lead center for commercial remote sensing, Stennis introduced WDET in the state of Mississippi two years ago. WDET has been given the task of ensuring that a trained workforce will be available to populate the rapidly growing remote-sensing industry. The Mississippi Model and the Mississippi Department of Education launched a program, which when fully implemented, will bring remote-sensing technology to every Mississippi student by 2003. This program has been the focus of national attention, bringing education officials from around the nation to Mississippi to observe the schools involved. Spatial Information Centers have been established in all Mississippi Community Colleges and Universities are investigating remote-sensing courses for existing disciplines.

NASA, the US Department of Education, the US Department of Labor, the US Department of Agriculture, the US Department of Interior and the US Department of Defense will work together to ensure that all students are exposed to remote-sensing technology. Industries, colleges and universities will also be part of the network. Additionally, NASA will draw on its existing partnerships with the Smithsonian Institution, National Geographic, the Public Broadcasting Service and the Global Learning and Observations to Benefit the Environment program.

CONTACT: Brenda Pounds, Stennis Space Center, Building 1200, Stennis Space Center, MS 39529; Phone: (228) 688-3814; Fax: (229) 688-7528; Email: brenda.pounds@ssc.nasa.gov

NOVA

http://www.eng.ua.edu/~nova

NOVA was created to develop and disseminate a national framework for enhancing science, mathematics, and technology literacy for teachers in the 21st century. The NOVA consortium, with the University of Alabama Fayetteville State University and the University of Idaho as lead institutions, is working to produce enhanced science, mathematics and technology literacy for new teachers. This effort is accomplished through the demonstration of an undergraduate science/math/technology course framework, examples of successful course models, and a mentoring support system for faculty wishing to implement new courses or modify existing courses at their universities. The framework uses interactive learning and integrates science, mathematics and technology as a means of developing a new paradigm for educating teachers. NOVA invites the participation of science, mathematics, engineering, technology, and education faculty who are concerned with how universities prepare new teachers. Using the NASA mission, facilities, and resources, NOVA provides faculty with enhanced knowledge and skills to implement change in university courses. The NOVA team presents its framework for change primarily through three-day workshops to interdisciplinary university teams. These universities are then eligible to

submit proposals for Implementation Planning Grants (up to $30,000 for a one-year period) to initiate change in science, mathematics, or engineering courses for preparing K–12 teachers. In addition, the project links participants together through a World Wide Web server, which provides the means for faculty and students to exchange and have access to the model, materials, activities, and updated information.

The schedule of workshops and application information is available at **http://www.eng.ua.edu/~nova.** Each participating university or college must identify an interdisciplinary faculty team for the workshop. One team member must be a faculty member in the College of Education. A second team member must be a faculty member in science, mathematics, engineering, or technology. The third team member should be a university or college administrator (e.g., provost, dean, or department head). Applying teams must have access to interactive technologies and the Internet for classroom use. A memorandum of understanding signed by the deans of each college or division participating in the project must be submitted to demonstrate a university-wide commitment.

CONTACT: L. Michael Freeman, Aerospace Engineering & Mechanics, University of Alabama, Box 870280, Tuscaloosa, AL 35487-0280; Phone: (205) 348-7304; Fax: (205) 348-4171; Email: nova@coe.eng.ua.edu or mfreeman@coe.eng.ua.edu

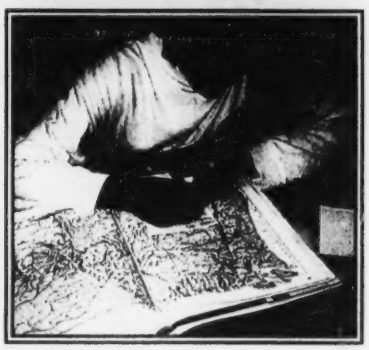
University Based Program in Earth System Science Education (ESSE)

http://www.usra.edu/esse/essonline/

The *ESSE* program consists of faculty from 44 U.S. universities who are linked with one another and with NASA scientists in the development of undergraduate curricula in Earth system science. Managed by the Universities Space Research Association (USRA), the program offers financial incentives to universities that are willing to participate cooperatively with other universities and NASA in interdisciplinary curricula development for Earth system science education. Each university in the program has developed a survey course and senior-level courses in which faculty present Earth system issues as a socially-relevant, challenging, and important class of scientific problems. The objective of the survey-level course is to instill among the general student population an appreciation of the social, economic, and political implications of global change, and a scientific understanding of interrelationships between the Earth's physical and climate system and ecological systems. The objective of the advanced senior-level course is to provide students in the sciences and mathematics with an interdisciplinary perspective of Earth science and global change research. In the senior course, students from different academic departments work in teams to study and develop conceptual and computer models of physical, chemical, and biological processes of the Earth system. The senior course is taught by faculty from at least two relevant academic departments, and focuses on scientific issues that draw upon the strengths of the institution. As part of the broader program, universities participate in an organized exchange of scientists and faculty, involving visiting faculty and scientists from other participating universities and from NASA Centers.

CONTACTS: Donald Johnson, Phone: (608) 262-2538, Email: donj@ssec.wisc.edu; Michael Kalb, Phone: (301) 805-8396, Email: mkalb@gvsp.usra.edu; Martin Ruzek, Phone: (920) 732-4514, Email: ruzek@usra.edu; Universities Space Research Association, 7501 Forbes Blvd, Suite 206, Seabrook, MD 20706

Curriculum Support And Dissemination



Curriculum support includes the development, use, and distribution of science, mathematics, and technology instructional products and curriculum based upon the Earth Science Enterprise's unique mission and results. These activities include support for elementary through college-level curricula and focuses on an interdisciplinary approach that supports national education standards. A listing of specific Earth Science Enterprise education products and how to obtain them is included in the section starting on page 62. This section provides information on NASA-sponsored curriculum development and support projects.

ELEMENTARY & SECONDARY

Access Earth

http://www.usm.maine.edu/coe/mecats/earth/

Access Earth is a program for high school students with disabilities and teachers to encourage students with disabilities to enter careers in Earth system science. Students and teachers attend an intensive week-long summer institute focusing on land-ocean-atmosphere interactions, with field activities based at the Wells National Estuarine Research Reserve on the coast of Maine. Topics to be covered include climate change and sea level rise, land use changes, atmospheric pollution, and coastal watershed management. Participating teachers will work with scientists, educators, and students with disabilities to develop, test, and refine accessible Earth system science curriculum. Students will work with scientists, collecting and analyzing scientific data, and will learn about career opportunities in Earth system science.

The institute will typically be offered in July, but interested persons should check the Web site for further information. The program will run in the summers of 2000, 2001, and 2002, and is limited each year to ten teachers and fifteen students from Maine, New Hampshire, or Vermont. High school teachers of Earth science, general science, or environmental science are especially encouraged to apply, but applications will be accepted from other disciplines. Students should be entering ninth or tenth grade. Participating teachers are expected to further test and refine curriculum in their classrooms during the school year. Course materials and room and board are provided. Participants also receive a $500 stipend upon successful completion of the institute.

CONTACT: Nancy Lightbody, College of Education and Human Development, University of Southern Maine, 328 Bailey Hall, Gorham, ME 04038; Phone: (207) 228-8115; Fax: (207) 780-5224; Email: nancy@lightbody.org

Consortium for the Application of Space Data to Education (CASDE)

A wide variety of training opportunities for pre-service and in-service teachers are available through the ***Consortium for the Application of Space Data to Education (CASDE).*** This consortium was created to provide mechanisms to integrate NASA's extensive data holdings and advanced information system technologies into education. CASDE is dedicated to providing the educational community with vast amounts of NASA imagery, tools, educational resources,

and interdisciplinary activities. CASDE tools, tutorials, a useful "building-block" curriculum structure, classroom ready posters, and interactive laboratory kits, have all been developed by the consortium to introduce the basics of interpreting space imagery and incorporating potential applications of NASA data to the education community and other interested parties.

The leadership of CASDE comes from three organizations, including the University of Nebraska at Lincoln, Center for Advanced Land Management Information Technologies, the Jet Propulsion Laboratory, and the University of Nebraska at Omaha Office of Internet Studies. Through these three organizations, the CASDE staff offers a variety of periodic staff development opportunities for educators (both pre-service and in-service) and other professionals (such as resource managers), who are interested in gaining more information or training-related CASDE resources. For example, one-day introductory seminars are available that introduce participants to CASDE imagery resources, sample curriculum activities, and software. Weeklong workshops are also offered periodically to provide teachers and other professionals a more in-depth training in CASDE resources, image visualization tools, and lesson design. The workshops also assist teachers in developing curriculum specific to their classrooms. In addition to these shorter duration opportunities, several graduate courses, and extended independent study classes for graduate credit, are also available from the University of Nebraska at Omaha. Web-based training opportunities, called "Webshops" are also being developed by the consortium. Within all the training opportunities, educators are involved in a wide variety of "hands-on" activities to help support a strong base of CASDE resource awareness, experience, and classroom integration. Participants particularly gain valuable experience with new technology-based tools, such as DataSlate, which is a new technology that allows users to explore essentially infinite data sets and to simultaneously compare co-registered and geo-referenced sets of data. DataSlate is being developed by the Jet Propulsion Laboratory.

CASDE invites partnering with other organizations to help provide such teacher training opportunities in various locations, and actively seeks collaboration with teachers and other professionals who are interested in expanding CASDE curriculum efforts.

CONTACTS: Paul Clark, Office of Internet Studies, UNO, Omaha, NE, 68182-0163; Email: Paul_Clark@unomaha.edu

Rick Perk, University of Nebraska, Lincoln, 113 Nebraska Hall, Lincoln, NE 68588-0517; Email: rperk@tan.unl.edu

The Dynamic Earth

http://www.discoverycube.org

Discovery Science Center is an interactive science center with over 100 hands-on exhibits augmented by educational programming and materials providing learning opportunities for students, teachers, and family audiences. *The Dynamic Earth* program includes:

- Resource materials and kits provide the classroom teachers with a set of hands-on materials that will enable the students to design and test experiments. The curriculum packet contains science content information, vocabulary list, a materials list, timeline for preparation and implementation, tips for managing the students or classroom during hands-on experiences, a bibliography of additional materials, and a collection of professional contacts.
- Teacher training program in the use of these materials and lesson plans. This six-hour training, along with the teacher's guide and kit will enable two to three weeks of classroom instruction.
- An interactive science presentation for the classroom or general public.
- Family science nights at the science center. These evenings will introduce families to the science programs presented in the schools. Families will observe science demonstrations, attend science lectures, interact with the hands-on exhibitry, such as an earthquake simulation room, an eight-foot free-standing tornado, and a kalliroscope that models the fluid dynamics of the ocean and/or the atmosphere.

Some of the concepts the participants in The Dynamic Earth program will investigate are:

- Plate tectonics and the changing patterns of land, sea and mountains on the Earth's surface;
- How the Sun's heating of the Earth's surface drives convection within the atmosphere and oceans, producing winds and ocean currents, leading to an understanding of global weather patterns and geographical distribution of marine and terrestrial organisms; and
- Human impact on the Earth's atmosphere, and in turn how the altered atmospheric conditions affect all life on Earth.

Interested parties should contact the Education Department or Group Bookings at (714) 542-2823.

CONTACT: Janet Yamaguchi, Vice President, Education, Discovery Science Center, 2500 North Main Street, Santa Ana, CA 92705; Phone: (714) 542-2823; Fax: (714) 542-2828; Email: jyamaguchi@discoverycube.org

Earth Systems Connections: An Integrated K–4 Science, Mathematics, and Technology Curriculum

http://www.ias.sdsmt.edu/staff/vierling/vierling.html

This project will develop an integrated Earth system science curriculum program intended for children in K–4 classrooms. At the core of the work are three central objectives:

1. To build upon existing data, technologies and resources (e.g. NASA satellite imagery and programs) in the creation of approximately 50 thematic, integrated, stand-alone activities that are cohesively connected across K–4 grade levels. These activities will reflect national content and process standards for elementary level mathematics and science education.
2. To develop modules around real-world, scientific, and cultural contexts that resonate with typically disadvantaged and underrepresented populations. Collaborative relationships with schools on a Native American reservation, in rural Appalachia, and in inner city areas have already been secured.
3. To support the curriculum by developing interactive Web sites through which students will enter and access data, observe satellite imagery, post findings, etc., forums where students across the country could communicate with each other (e.g., email, chat rooms, videoconferencing), as well as support for online conversations between teachers as a form of teacher development will be provided.

Four themes will be developed to provide the content framework for creating the curricular activity modules, namely: 1) Learning about Remote Sensing Principles and Connections to Earth System Science; 2) Learning about the Earth's Dynamic Systems: Interconnections that Link the Earth; 3) Learning about the Earth's Dynamic Systems: Changes, Changes Everywhere!; and 4) Learning about the Earth's Dynamic Systems: Measurement and Data Analysis. Curriculum modules will revolve around "hands-on" activities, supported and supplemented by Web based lessons. Extensive piloting of the curriculum modules will take place throughout the duration of the grant at six school sites (two each in South Dakota, Colorado, and Virginia). The project will officially begin in June 2000 and welcomes the opportunity to collaborate with other schools, educators, and researchers.

CONTACT: Lee Vierling, SDSM&T, 501 E. St. Joseph St., Rapid City, SD 57701; Phone: (605) 394-6855; Fax: (605) 394-6061; Email: Lee.Vierling@sdsmt.edu

EarthKAM

http://www.earthkam.ucsd.edu/

EarthKAM enables students to explore and learn about Earth using images taken from the unique and powerful perspective of space. EarthKAM has accumulated a wealth of images, taken remotely by middle school students operating an electronic still camera flown in Earth orbit. These visible-light images show a diversity of regions and physical features, from every continent except Antarctica—all available on the educational, user-friendly, Web-based data system. Educational materials are also available online to help educators get started with the program and integrate working with images into their classrooms and curricula.

EarthKAM's main objectives are:

- To integrate Earth images with inquiry-based learning to enhance curricula in support of national and state education standards;
- To provide students and educators the opportunity to participate in a space mission and to develop teamwork, communication, and problem solving skills;
- To engage teams of students, educators, and researchers in collaborative investigations using remotely-sensed data; and
- To incorporate the active use of Web-based tools and resources in support of the learning process.

Educators for grades 5 through 12 are invited to use the EarthKAM images and materials available on the EarthKAM Web site. Middle schools also have the opportunity of applying to join the online EarthKAM Community. The community provides additional information and support for students and educators as they conduct collaborative, inquiry-based investigations based upon the images and their classroom studies. Details on the benefits of and requirements for joining the EarthKAM Community are available on the Web site.

EarthKAM is a collaboration among NASA, the University of California, San Diego, and TERC's Center for Earth and Space Science Education.

CONTACT: EarthKAM Coordinator, Center for Earth and Space Science Education, TERC, 2067 Massachusetts Ave, Cambridge, MA 02140; Phone: (617) 547-0430; Fax: (617) 349-3535; Email: EarthKAM_Coordinator@TERC.edu

Enhancement of the Global Systems Science Student Guide Scries for the Digital Earth Initiative

Atmospheric and Environmental Research, Inc., Boston's Museum of Science, Lawrence Hall of Science in Berkeley, CA, and Logal.net will digitize and enhance the ***Global Systems Science (GSS) Student Guide Series*** for interactive use on the Internet and the ***Digital Earth Initiative.*** The GSS Student guide series, developed during the past eight years at the Lawrence Hall of Science, can be combined in various ways to create an interdisciplinary high school course. In

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the GSS approach students integrate the traditional disciplines to probe the interactions among the atmosphere, ocean, ice, solid Earth, and living organisms that shape Earth's evolution and its future. Students study the traditional disciplines, not as ends in themselves, but as tools for a scientific understanding of Earth as an integrated system. The course draws on a variety of disciplines to illustrate how scientists investigate the ways that human activities interact with Earth systems. The content and pedagogy of the Global Systems Science course reflects the four goals that lie at the heart of the National Science Education Standards:

- GSS starts with real-world societal issues selected to evoke interest, excitement, and an appreciation of the value of science.
- Through laboratory activities and discussions, students are given opportunities to investigate and apply the scientific processes and principles that inform each of the issues.
- Students are encouraged to discuss their changing perspectives as the course proceeds, and to think about how they can affect the outcome in each area of concern through personal decisions.
- Students are motivated to continue their study of technical fields as they encounter a wide diversity of role models featured in the GSS Student guides.

The nine-part GSS Student guide series will be digitized, not only by creating hypertext links between the documents, but by developing an educational software interface that creates organic, living documents connected to any data accessible on the Internet. Logal.net has developed revolutionary software that displays, overlays, and interacts with any Internet data source on one computer screen. Science, education, research, technology, and public policies will all be integrated and available for students, public planners, the media, and the general public to explore, analyze, and make decisions.

CONTACT: John Pickle, Staff Scientist for Education Development, Atmospheric and Environmental Research, Inc. (AER), 840 Memorial Drive, Cambridge, MA 02139-3771; Phone: (617) 349-2277; Fax: (617) 661-6479; Email: jpickle@aer.com

The Gaia Crossroads Project

http://www.bigelow.org/~gaia/menu.html

The Gaia Crossroads Project is an innovative program using satellite remote sensing in K–12 classrooms. This progressive program captures the interest of elementary students and sustains their interest through high school. Using the imagery provided, students are able to study and interpret satellite images of their local communities. After the initial focus on the local environment, the program expands to include images of a broader geographic coverage-the Gulf of Maine and the North Atlantic for studying oceanography, weather satellite images for studying meteorology, and images of tropical rain forests for studying global ecosystems. The project provides ongoing teacher training and technical support.

The Gaia Crossroads Project's future plans include conducting a three-year pilot project in Maine to demonstrate that students can produce an accurate land use/land cover map of their state that will prove of value to state government. Another future plan is for a two-year pilot program to develop a new approach to a comprehensive study of the water cycle. Students and teachers will use NASA data and other imaging products to follow a drop of water from the time it falls as rain until it once again becomes a raindrop. The protocols, training modules, and strategies developed in these pilots would become models for students and teachers in other states.

The Gaia Crossroads Project Teachers Guidebook for Using Satellite Imagery in the Classroom and Community is available through Bigelow Laboratory. It contains background information on the project, a remote-sensing primer, hands-on tutorials, ideas for setting up the program in a classroom, over sixty activities written and classroom tested by teachers in the Gaia Crossroads Project, and an extensive listing of resources.

CONTACT: Cynthia B. Erickson, Project Director, The Gaia Crossroads Project, Bigelow Laboratory for Ocean Sciences, P.O. Box 475, McKown Point, West Boothbay Harbor, ME 04575-0475; Phone: (207) 633-9600; Fax: (207) 633-9641; Email: gaiaxroads@bigelow.org

Goddard Institute for Space Studies (GISS)—Institute on Climate and Planets (ICP)

http://icp.giss.nasa.gov

ICP's mission is to contribute an innovative model for teaching and learning science that connects NASA's climate system research to national science standards and foster the professional/academic advancement of minority students in the sciences. The ICP is conducted in collaboration with the City University of New York (CUNY), Columbia University, New York City Public Schools, and Science Systems and Applications, Inc.

Student Research Interns and Faculty Fellows are competitively selected from New York City area pre-college and college institutions and given tangible roles on GISS research teams organized to advance our understanding of climate forcings and natural variability that produce climate change. Activities during Summer Institutes (six-eight weeks) and an Academic Year Program (GISS- and school-based) are designed to facilitate research projects and develop relevant science skills and content understandings. Annually, student researchers at GISS and/or ICP schools make presentations at science fairs, regional and national science competitions and the ICP Spring and Summer Conferences. ICP students view research experiences as a

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means to their advancement in the science pipeline, with program alumni now entering highly competitive schools and job markets. Throughout the year, ICP faculty and GISS scientists collaborate to produce student projects and lessons, as well to share them at professional meetings and conferences.

With the support of NASA's Minority University–Space Interdisciplinary Network Resource Training Site at the City College of New York (CCNY), ICP schools are gaining the technical competencies and resources needed to participate in an electronically connected research and education network.

An Earth Climate Teacher Education Course and school-based Teacher Institutes are the newest components under development. The context for the course and institutes is to examine the Earth's climate as an evolving, dynamic system by investigating how the input solar radiation interacts with the system characteristics to produce the output climate conditions. Partnerships with Columbia University, CUNY and New York City Urban Systemic Initiative are contributing to these teacher courses and institutes.

CONTACT: Carolyn Harris, NASA Goddard Institute for Space Studies, 2880 Broadway, New York, NY 10025; Phone: (212) 678-5653; Fax: (212) 678-5552; Email: charris@giss.nasa.gov

GSFC Earth and Space Sciences Education Project (GESSEP)

http://education.gsfc.nasa.gov/

A repository of online investigations for grades 5–8 and 9–12 have been developed by teachers from Maryland, Connecticut, and West Virginia during summer workshops at Goddard Space Flight Center. The focus of these workshops is on developing investigations directly related to NASA Earth and space science projects. Participating teachers are paired with scientists from various NASA projects to accomplish this objective.

Pilot testing of the investigations is occurring during the 1998–2000 school years. Classroom teachers register to pilot individual investigations in their classrooms by going to the following Web site: **http://www.education.gsfc.nasa.gov/** and clicking on the ***GESSEP*** logo. GESSEP strives to collect 25–30 evaluations per investigation. This feedback will be used to refine the Investigations and determine the relative value of each investigation in the classroom.

CONTACTS: Stephen Gilligan, Principal Investigator; Phone: (301) 375-8226; Email: charles1@mail.ameritel.net

Vern Smith, Co-Investigator, GSFC, Code 130.9, Greenbelt, MD 20771; Phone: (301) 286-1977; Email: vern@aesp.nasa.okstate.gov

GSFC Earth Sciences Directorate Scientific and Educational Endeavors (SEE)

http://See.gsfc.nasa.gov/

SEE focuses on enabling the use of NASA Earth science information and data for formal and informal education. This program develops educational products for high school and undergraduate educators and for students at these levels. It also works with organizations and individuals involved in informal education throughout the U.S. to jointly produce useful educational and public awareness materials that utilize NASA's Earth science knowledge and expertise.

CONTACTS: Blanche Meeson, NASA Goddard Space Flight Center, Earth Sciences Directorate, Code 900, Greenbelt, MD 20771; Email: bmeeson@see.gsfc.nasa.gov

Carla Evans, Goddard Space Flight Center, Earth Sciences Directorate, Code 900, Greenbelt, MD 20771; Email: cevans@see.gsfc.nasa.gov

Learning Technologies Project

http://education.nasa.gov/ltp

The NASA *Learning Technologies Project* (LTP) uses NASA's inspiring mission, unique facilities, and specialized workforce, along with the best emerging technologies, to promote excellence in America's educational system. LTP funds activities that deliver NASA mission content via the Internet and other technologies to foster reform and restructuring in math, science, computing, engineering, and technical education.

LTP promotes effective use of NASA information and knowledge for education and life-long learning by means of:

- **Education Outreach Centers.** NASA LTP Center projects breathe life and immediacy into curricula—incorporating technology to enhance learning and using technological advances to serve educational goals. Among the many NASA Center projects are the NASA Quest Learning Technologies Channel, which allows a multi-dimensional Web experience incorporating email, chat rooms, audio, video, synchronized graphics, and sometimes NASA Television to offer participants workshops, lectures, seminars, courses, and exciting live events around the world.
- **Leading Educators to Applications, Research and NASA-related Educational Resources in Science (LEARNERS) Projects.** The seven LEARNERS projects launched in late 1999 to enhance K–12 science, mathematics, technology, and geography education through Internet-based products derived from content on NASA's mission. These projects feature topics in Earth science, space science, and aerospace technology.
- **Legacy Projects.** Funded by LTP in the past are projects ranging from those emphasizing innovative public use of remote-sensing data, to those

using Digital Library Technology, to those with an aeronautics focus in grades K–14.

CONTACT: Mark León, NASA ARC, MS 269-3, Moffett Field, CA 94035; Phone: (650) 604-6498; Email: mleon@mail.arc.nasa.gov

Maryland Earth and Space Systems Science Curriculum Project

NASA's Goddard Space Flight Center Education Office is collaborating with two Maryland school systems, Anne Arundel County Public Schools and Montgomery County Public Schools, to develop a new high school *Earth and Space Systems Science Curriculum.* This curriculum will address the National Science Education Standards and Maryland's "Core Learning Goals"—**http://mdk12.org/mspp/high_school/what_will/science/index.html**—which will provide the basis for high school performance tests. The curriculum will use a systems approach and be grounded in current Earth and Space System Science content. Two courses are being developed: 1) a course for students in grades nine or ten (with Algebra 1 as a pre-/co-requisite) and 2) a course for students in grades eleven and twelve (with Algebra 2 as a pre-/co-requisite).

The writing team is using information provided by NASA scientists as a basis for the content. The "five E" format, from Constructivist Learning Theory—**http://www.exploratorium.edu/IFI/resources/constructivistlearning.html**—is providing the skeleton for the curriculum design. Throughout curriculum development, Goddard's scientists will be consulted by the writing team to ensure that the science is correct and that the latest scientific facts, theories, and processes are incorporated into the curriculum. An advisory board will be identified to review the curriculum writing efforts.

Initial implementation of the first level of the course is planned for September, 2000 with revisions to the first course and development of the second level course planned for the 2000/2001 school year. Goddard will provide a Web site for curriculum dissemination so that the curriculum will be made available to other school systems.

CONTACT: John Entwistle, Goddard Space Flight Center, Code 130.3, Building 28, Room N167A, Greenbelt, MD 20771; Email: jentwist@pop100.gsfc.nasa.gov

NASA Goddard Space Flight Center Earth System Science Education Project (GESSEP)—Maryland School System Grants and Regional Earth Science Activities

As an extension to the Maryland Ambassador Program, *GESSEP* teacher ambassadors are deeply involved in enhancing Earth and Space science instruction in their local systems and throughout Maryland. Professional development and curriculum planning workshops are supported through grants under this program. Examples of activities supported by this program include:

- A workshop was held at Easton High School, and involved 50 Earth Science Teachers in the nine Eastern Shore counties of Maryland. The workshop was related to the identification of support structures needed by schools and districts to implement the Core Learning Goals for High School Earth, and Space Sciences.
- The Western Maryland counties of Allegany, Garrett, and Washington provided three days of staff development, planned and presented by Ambassadors, for all Earth and Space Science Teachers.
- Four teams of teachers from the five Southern Maryland Counties of Prince George's, Calvert, Charles, St. Mary's, and Anne Arundel completed their work, in early August 1998, to infuse technology into the Earth Science Curriculum developed by Baltimore County. The revised curriculum was to be piloted in the five involved counties during the 1998–1999 school year, with the piloted curriculum made available to all counties in the state.
- A GESSEP Ambassador and the Science Supervisor planned and conducted a two-day in-service for Earth science teachers in Calvert County.

Applicants are limited to participants from the Maryland Ambassador Program and selected on a competitive basis.

The Maryland Ambassador Program began in 1994, continuing through the end of the 1996 school year. Teams of Maryland middle and high school teachers participated in this four-week summer program, which was designed to enhance their teaching and help them serve as ambassadors to other teachers and to their local school district. Sixty-five teachers completed the Ambassador Program from across Maryland.

CONTACTS: Stephen Gilligan, Principal Investigator; Phone: (301) 375-8226

Vern Smith, Co-Investigator, GSFC, Code 130.9, Greenbelt, MD 20771; Phone: (301) 286-1977; Email: vern@aesp.nasa.okstate.edu

NASA Native Earth Systems Science Curriculum Project (NESCP)

The All Nations Alliance for Minority Participation (ANAMP) is developing curriculum materials for K–4 education.

The Salish Kootenai College and its collaborative partners (the Colville and Nez Perce Tribes) have a unique and innovative plan to develop and field test a set of age-appropriate activities related to fields of Earth system science research and data assessment for the K–4 education community. A "trio" approach to curriculum development will be used

that includes two teachers (K–4 and high school) and one elder from each tribe involved (Confederated Salish and Kootenai Tribes, the Colville Tribe, and the Nez Perce Tribe). These trios will attend two training institutes annually. One institute will focus on Earth system science content areas and will be held at NASA Goddard. The second institute will focus on training in effective teaching practices already developed for Native American students by ANAMP. Each year, a Native American college student in his/her third year in elementary education or math and science secondary education programs will participate in the training institutes. Curriculum and appropriate assessment tools will be developed by the three trio teams of the ***NASA Native Earth Systems Science Curriculum Project (NESCP).*** Curriculum that meets assessment and evaluation criteria will be field tested in pilot modules within reservation schools. All curricula will be created in black and white, with standard size duplication in mind.

CONTACT: Dr. Judith Gobert, All Nations Alliance for Minority Participation, Salish Kootenai College, PO Box 117, Pablo, MT 59864; Phone: (406) 675-4800; Fax: (406) 675-4838

The Pigeon Adventure: An Adventure through Remote-Sensing History

The Pigeon Adventure is an interactive Web site and hands-on activities that are being developed to teach children in grades K through 4 about remote sensing and change over time. Set in New York City, the product will present science concepts via a Pigeon as metaphor familiar to inner-city children to introduce the concept of perspective and change in urban habitats. Through aerial photography created by pigeon cameras, the product will focus on the benefits of a bird's eye view then introduce the advances of remote sensing throughout the century.

The interactive adventure will engage children to follow a carrier pigeon on an adventure through New York City. They will be challenged to solve problems based on historical information gathered from the Pigeon's adventure and visual cues in the satellite imagery. These problems will emphasize how the city and its habitats have changed over time. Thus drawing a systemic relationship of urban development, change-over-time, and its effect on biodiversity.

The supplemental materials will enable educators to introduce and reinforce the concepts through hands-on activities linked to national standards. Parents and teachers will be able to teach Earth system science via identification of land use in remotely-sensed imagery, exploration of featured habitats, and through the investigation of the interactions and changes in these systems.

CONTACT: Ginger Butcher, NASA Goddard Space Flight Center, Mail Stop 920, Greenbelt, MD 20771; Phone: (301) 614-6540; Email: ginger@ltpmail.gsfc.nasa.gov

PUMAS (Practical Uses of Math And Science)

http://pumas.jpl.nasa.gov

PUMAS is an online journal of brief examples illustrating how math and science concepts taught in pre-college classes are actually used in everyday life. PUMAS offers a way for researchers to make a substantial contribution to education with a relatively small investment of time and effort.

PUMAS examples may be activities, anecdotes, descriptions of "neat ideas," formal exercises, puzzles, or demonstrations, written primarily by scientists, in any style that serves the material well. They are intended mainly to help K–12 teachers enrich their presentation of science and math in the classroom. The PUMAS Web site provides wide distribution; the site receives over 3,000 hits per week, on average.

Teachers can search the PUMAS collection based on curriculum topic, grade level, or subject. They can select relevant examples, and develop ideas of their own about how to integrate the material into their lesson plans.

All examples are peer-reviewed by at least one scientist with a relevant background, and at least one teacher at an appropriate grade level. Once accepted, an example is a citable reference in a refereed science education journal, and may be listed in your resume.

Interested in participating? The examples are available to everyone via the PUMAS Web site. The project also needs teachers at all grade levels, scientists, and engineers to volunteer for the pool of PUMAS reviewers. And the project is always looking for good examples of the Practical Uses of Math And Science.

CONTACT: Ralph Kahn, editor and founder, Jet Propulsion Laboratory, MS 169-237, 4800 Oak Grove Drive, Pasadena, CA 91109 USA; Phone: (818) 354-9024; Fax: (818) 393-4619; Email: ralph.kahn@jpl.nasa.gov

TOPEX/POSEIDON and Jason-1 Educational Outreach

http://topex-www.jpl.nasa.gov

Jointly sponsored by NASA and the French Space Agency (CNES) the ***TOPEX/POSEIDON*** satellite has continuously surveyed the ocean surface height with a radar altimeter since launch in 1992. Now operating beyond its design lifetime, it is hoped that TOPEX/POSEIDON will continue to collect data until fall of 2000 when the follow-on mission, ***Jason-1,*** will be launched.

Scientists are using TOPEX/POSEIDON satellite data, accurate to within 4cm, to learn about ocean circulation including phenomena such as the El Niño/La Niña

cycle. Oceans are a key mechanism in transporting heat from the sun around the globe. Researchers are working to improve the understanding of the role of oceans in controlling seasonal variations and longer-term climate changes. TOPEX/POSEIDON data are also used for operational purposes including ship routing, fisheries management, hurricane forecasting and support of underwater activities such as cable laying.

The TOPEX/POSEIDON and Jason-1 projects develop and provide a wide variety of physical oceanography materials to K–13 educators and students including CD-ROMs, posters, brochures and videos. Many resources are available through the Web. TOPEX/POSEIDON satellite data are posted on the Web and can be accessed for use in the classroom.

CONTACT: Susan Digby, Jet Propulsion Laboratory, M/S 263-355, 4800 Oak Grove Drive, Pasadena, CA 91109 USA; Phone: (818) 354-6036; Fax (818) 354-0368; Email: topex@jpl.nasa.gov

The Translingual Earth System Science Education Center

As NASA's Earth system science program advances, remarkable innovations in classroom technology promise a wider audience than ever. But in spite of the promise of reaching a broader audience, Earth system science remains a largely English-speaking phenomenon confined to university campuses. The multidisciplinary approaches and integrated tenets of Earth system science are nonexistent in most minority-dominated rural school districts of Texas and the U.S./Mexico borderlands. In the Spanish-speaking countries of Central and South America, a systems approach to Earth science education is likewise nonexistent.

In a joint international effort led by Texas A&M University-Corpus Christi, online technologies will be coupled with existing teacher cohort networks to deliver trilingual Earth system science content to Hispanic students and educators in Texas, Mexico, Puerto Rico, and selected Latin American countries.

CONTACT: Grady Blount, Texas A&M University-Corpus Christi, Dept. of Physical and Life Sciences, College of Science and Technology, 6300 Ocean Drive, CS 130, Corpus Christi, TX 78412; Phone: (361) 825-2358; Fax: (361) 825-2742

University of Montana's Earth Observing System (EOS) Education Project

http://www.eoscenter.com

This project disseminates EOS mission imagery, supportive curriculum, and relevant programs to the K–16 education community. The *EOS Education Project* also provides training for the K–16 educational community in the interpretation, utilization, and relevancy of EOS mission imagery. These resources are delivered through a dynamic combination of online and onsite teacher workshops, Internet-based courses, national conferences, interactive map and image servers, and Earth system science content.

Distributed and classroom-based Geographic Information Systems (GIS) are used to assist teachers to obtain remote-sensing imagery and ancillary data for project-based learning. We investigate how EOS information can enhance existing NASA interdisciplinary curriculums that explore the diverse and changing landscapes of the world.

The EOS Education Project has assembled a team of education, technology, and resource specialists to serve the growing needs of the global environmental education community. The project has also established strategic alliances within the private and public sectors to advance state-of-the-art solutions for geographical information dissemination and education program development across local, regional, and global scales. The collective mission supports educator and student understanding of complex global ecosystems and humans' role in affecting these systems.

CONTACT: Phone: 1-800-0411-0341; Email: umtonline@selway.umt.edu

COMMUNITY COLLEGE & UNDERGRADUATE

An Associate of Arts in Community Colleges for Training in Earth Science (ACTES)

http://www.smcccd.cc.ca.us/smcccd/csm/actes/actes.html

ACTES is a collaboration between the College of San Mateo (CSM) and NASA Ames Research Center, with three major goals. The first is implementing remote-sensing data use in a broad range of community college courses. Second, is creating curriculum modules and classes that are transportable to other community colleges via the World Wide Web (WWW). Third, at the end of the project, a WWW server will have been established that will be an ongoing source of data and curriculum materials to other community colleges.

A sequence of five courses has been established at CSM and approved for community colleges state-wide for students wishing to earn an AA degree in this area of expertise. The titles for the courses are: Introduction to Earth Systems Analysis; Spatial Analysis in Geographic Information; GPS, GIS and Image Processing; Remote Sensing Technology and Processing; and Laboratory Practicum.

The result of this curriculum will be hands-on learning for students whether they are at a two-year college for an AA degree, retraining to improve their job skills, taking classes to satisfy requirements for four-year colleges, or any

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combination of these options. The expectation is that these students will be able to continue their education in remote sensing/Geographic Information Systems (GIS) at a senior college, move into entry level positions at local companies where remote-sensing and GIS technologies are used, or have valuable skills to append to their resumes.

At the completion of the project, colleges throughout the nation will be able to download materials from the ACTES WWW site and use them for their own related course work and programs. These materials will include course outlines, classroom exercises, individual lessons, and supporting graphics and images.

CONTACTS: Ken Kennedy, Department of Political Science, College of San Mateo, 1700 W. Hillsdale Blvd., San Mateo, CA, 94402; Phone: (415) 574-6656; Fax: (415) 574-6680; Email: kennedy@smcccd.cc.ca.us

J. W. Skiles, SETI Institute, Mail Stop 239-20, NASA Ames Research Center, Moffett Field, CA 94035-1000; Phone: (650) 604-3614; Fax: (650) 604-1088; Email: jskiles@mail.arc.nasa.gov

Augmented Learning Environment and Renewable Teaching—(Project ALERT)

http://projectalert.nasa.gov

Project ALERT (Augmented Learning Environment and Renewable Teaching) is a cooperative California-based program with two main partners, the California State University (CSU) geoscience and education disciplines and the NASA centers at Ames Research Center (ARC) and the Jet Propulsion Laboratory (JPL). Project ALERT is a three-year initiative that formally began in spring 1998 with funding from NASA and nine CSU campuses; two additional campuses have been recruited since the inception of the project. The shared goals are to build strong bridges between NASA scientists, engineers, and science information technologists at ARC and JPL, and university educators and scientists at the CSU. CSU is one of the largest education systems in the world composed of twenty-three campuses; the system prepares a large percentage of teachers in the state. A primary emphasis of ALERT is to create and/or infuse interdisciplinary Earth science course materials into the core science curriculum of pre-service teachers.

The types of projects undertaken by CSU and NASA professionals include repackaging Earth sensing information generated by NASA missions for educational uses, effecting simpler transfers of NASA technology to education, and reassessing and augmenting university-level Earth science course content. ALERT also ties strongly to other NASA-sponsored educational outreach efforts within the Universities Space Research Association-Earth System Science Education (USRA-ESSE) and NASA Opportunities for Visionary Academics (NOVA) communities.

In practice, CSU professors spend up to ten weeks for each of two summers at the NASA centers. Design of academic year joint NASA-CSU projects is done during the summer as well as the development of "spin-off" joint NASA-CSU mission-related projects. Local and regional workshops at the CSU campuses and the NASA centers are conducted during the year to facilitate the exchange of information, as are continuing research and education efforts between NASA and CSU colleagues, including creating educational products (lesson plans, Web sites, etc.) and formative assessment of team-building activities.

CONTACTS: ARC—J. W. Skiles, SETI, NASA Ames Research Center, Email: jskiles@mail.arc.nasa.gov; JPL—Edward Ng, Email: Edward.Ng@jpl.nasa.gov; CSU North—Ellen Metzger, San Jose State University, Email: metzger@geosun1.sjsu.edu; CSU South—Elizabeth Ambos, California State University, Long Beach, Email: bambos@csulb.edu; other ALERT leaders include Marguerite Syvertson, JPL, Email: mlss@scn1.jpl.nasa.gov

Earth System Science Education Alliance (ESSEA)

http://www.cet.edu/essea

The Earth System Science Education Alliance (ESSEA), a partnership between the Institute for Global Environmental Strategies (IGES), the Center for Educational Technologies (CET) at Wheeling Jesuit University, through funding from NASA's Earth Science Enterprise, is an exciting and innovative professional development program.

ESSEA will support universities, colleges, and science education organizations in offering K–12 Earth system science (ESS) online graduate courses that have been developed within the CET at Wheeling Jesuit University for NASA's Earth Science Enterprise. The Earth system science courses use an innovative instructional design model, are delivered over the Internet, and feature student-centered, knowledge-building virtual communities. Successful proposers will participate in an intensive four-day training workshop to learn how to deliver the courses.

The ESS courses feature student-centered, knowledge-building communities in which groups of teacher/participants engage in problem solving, model building, and classroom activity design. A master teacher and/or an Earth system scientist, who act as guides and mentors throughout the 16-week courses, moderate participants. Participants' expectations are set through the use of rubrics for individual and group work as they learn new ESS content, become knowledgeable about new resources, develop confidence in the use of technology, and design new classroom activities.

IGES will award three-year grants to entities with unique and innovative proposals to facilitate and offer the Earth system science online courses developed and tested by CET. Plans are to issue new grants in early 2000, late 2000, and in 2001. A copy of the full proposal and guidelines is available at the ESSEA Web site—**http://www.cet.edu/essea**—or by mail at the address below.

CONTACT: Claudia Dauksys, ESSEA Program Associate, Institute for Global Environmental Strategies, 2111 Wilson Blvd., Suite 700, Arlington, VA 22201; Phone: (703) 875-8634; Fax: (703) 875-8635; Email: essea@strategies.org

National Workforce Development Education and Training Initiative

Building a strong work force to populate one of the fastest growing industries in the nation is one of the challenges facing NASA's Commercial Remote Sensing Program (CRSP) at Stennis Space Center. On October 1, 1999, CRSP, along with NASA's Education and University Affairs Office at Stennis, announced a national program that is designed to meet that challenge.

The national plan is based on the successful approach demonstrated by the Mississippi Model for ***Workforce Development Education and Training*** (WDET), currently being implemented by CRSP's Mississippi Space Commerce Initiative. As NASA's lead center for commercial remote sensing, Stennis introduced WDET in the state of Mississippi two years ago. WDET has been given the task of ensuring that a trained workforce will be available to populate the rapidly growing remote-sensing industry. The Mississippi Model and the Mississippi Department of Education launched a program, which when fully implemented, will bring remote-sensing technology to every Mississippi student by 2003. This program has been the focus of national attention, bringing education officials from around the nation to Mississippi to observe the schools involved. Spatial Information Centers have been established in all Mississippi Community Colleges and Universities are investigating remote-sensing courses for existing disciplines.

NASA, the US Department of Education, the US Department of Labor, the US Department of Agriculture, the US Department of Interior and the US Department of Defense will work together to ensure that all students are exposed to remote-sensing technology. Industries, colleges and universities will also be part of the network. Additionally, NASA will draw on its existing partnerships with the Smithsonian Institution, National Geographic, the Public Broadcasting Service and the Global Learning and Observa-tions to Benefit the Environment program.

CONTACT: Brenda Pounds, Stennis Space Center, Building 1200, Stennis Space Center, MS 39529; Phone: (228) 688-3814; Fax: (228) 688-7528; Email: brenda.pounds@ssc.nasa.gov

NOVA

http://www.eng.ua.edu/~nova

NOVA was created to develop and disseminate a national framework for enhancing science, mathematics, and technology literacy for teachers in the 21st century. The NOVA consortium, with the University of Alabama, Fayetteville State University and the University of Idaho as lead institutions, is working to produce enhanced science, mathematics and technology literacy for new teachers. This effort is accomplished through the demonstration of an undergraduate science/math/technology course framework, examples of successful course models, and a mentoring support system for faculty wishing to implement new courses or modify existing courses at their universities. The framework uses interactive learning and integrates science, mathematics and technology as a means of developing a new paradigm for educating teachers. NOVA invites the participation of science, mathematics, engineering, technology, and education faculty who are concerned with how universities prepare new teachers. Using the NASA mission, facilities, and resources, NOVA provides faculty with enhanced knowledge and skills to implement change in university courses. The NOVA team presents its framework for change primarily through three-day workshops to interdisciplinary university teams. These universities are then eligible to submit proposals for Implementation Planning Grants (up to $30,000 for a one-year period) to initiate change in science, mathematics, or engineering courses for preparing K–12 teachers. In addition, the project links participants together through a World Wide Web server, which provides the means for faculty and students to exchange and have access to the model, materials, activities, and updated information.

The schedule of workshops and application information is available at **http://www.eng.ua.edu/~nova.** Each participating university or college must identify an interdisciplinary faculty team for the workshop. One team member must be a faculty member in the College of Education. A second team member must be a faculty member in science, mathematics, engineering, or technology. The third team member should be a university or college administrator (e.g., provost, dean, or department head). Applying teams must have access to interactive technologies and the Internet for classroom use. A memorandum of understanding signed by the deans of each college or division participating in the project must be submitted to demonstrate a university-wide commitment.

CONTACT: L. Michael Freeman, Aerospace Engineering & Mechanics, University of Alabama, Box 870280, Tuscaloosa, AL 35487-0280; Phone: (205) 348-7304; Fax: (205) 348-4171; Email: nova@coe.eng.ua.edu or mfreeman@coe.eng.ua.edu

Remote Sensing Core Curriculum

http://www.umbc.edu/rscc

The Remote Sensing Core Curriculum (RSCC), sponsored by the International Center for Remote Sensing Education (ICRSE), NASA, and the American Society for Photogrammetry and Remote Sensing (ASPRS), is an education program developed in cooperation with international experts and businesses to ensure an au-thoritative and substantive curriculum in remote sensing. The curriculum includes a series of lecture outlines, accompanied by self-contained laboratory exercises developed to support the advancing technologies of remote sensing and its integration with spatial information systems. Digital data sets from existing and planned satellite missions will enhance the understanding of advanced concepts. The RSCC design will ensure full access to data sets, operating software, and lecture materials via the RSCC home page. The lecture series is organized under five volumes:

Vol. 1: Airphoto Interpretation and Photogrammetry

Vol. 2: Overview of Remote Sensing of the Environment

Vol. 3: Introductory Digital Image Processing;

Vol. 4: Remote-Sensing Applications; and

Vol. 5: K–12 Education.

CONTACT: Joyce Foresman, International Center for Remote Sensing Education (ICRSE), UMBC Technology Center, 1450 S. Rolling Road, Box 2-11, Baltimore, MD 21227; Phone: (410) 455-5573; Fax: (410) 455-5575; Email: icrse@symposia.org

University Based Program in Earth System Science Education (ESSE)

http://www.usra.edu/esse/essonline/

The *ESSE* program consists of faculty from 44 U.S. universities who are linked with one another and with NASA scientists in the development of undergraduate curricula in Earth system science. Managed by the Universities Space Research Association (USRA), the program offers financial incentives to universities that are willing to participate cooperatively with other universities and NASA in interdisciplinary curricula development for Earth system science education. Each university in the program has developed a survey course and senior-level courses in which faculty present Earth system issues as a socially-relevant, challenging, and important class of scientific problems. The objective of the survey-level course is to instill among the general student population an appreciation of the social, economic, and political implications of global change, and a scientific understanding of interrelationships between the Earth's physical and climate system and ecological systems. The objective of the advanced senior-level course is to provide students in the sciences and mathematics with an interdisciplinary perspective of Earth science and global change research. In the senior course, students from different academic departments work in teams to study and develop conceptual and computer models of physical, chemical, and biological processes of the Earth system. The senior course is taught by faculty from at least two relevant academic departments, and focuses on scientific issues that draw upon the strengths of the institution. As part of the broader program, universities participate in an organized exchange of scientists and faculty, involving visiting faculty and scientists from other participating universities and from NASA Centers.

CONTACTS: Donald Johnson, Phone: (608) 262-2538, Email: donj@ssec.wisc.edu; Michael Kalb, Phone: (301) 805-8396, Email: mkalb@gvsp.usra.edu; Martin Ruzek, Phone: (920) 732-4514, Email: ruzek@usra.edu; Universities Space Research Association, 7501 Forbes Blvd, Suite 206, Seabrook, MD 20706

University of Montana's Earth Observing System (EOS) Education Project

http://www.eoscenter.com

This project disseminates EOS mission imagery, supportive curriculum, and relevant programs to the K–16 education community. The *EOS Education Project* also provides training for the K–16 educational community in the interpretation, utilization, and relevancy of EOS mission imagery. These resources are delivered through a dynamic combination of online and onsite teacher workshops, Internet-based courses, national conferences, interactive map and image servers, and Earth system science content.

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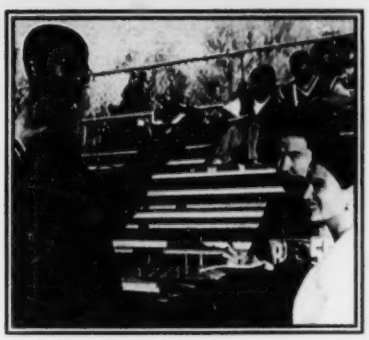
CONTACT: Phone: 1-800-0411-0341; Email: umtonline@selway.umt.edu

EDUCATIONAL TECHNOLOGY



Educational technology is a rapidly growing area for NASA's Earth science education program. These technologies include data visualization of complex datasets; distance education through telecommunications and Internet-based courses and research projects; mission simulations; and the design and/or use of instruments, ranging from simple to sophisticated, to collect Earth science measurements. These advanced technologies are used in NASA Earth science education projects across all levels.

Challenger Center for Space Science Education

http://www.challenger.org/

Challenger Center for Space Science Education is an international, not-for-profit education organization created in 1986 by the families of the astronauts tragically lost during the Challenger space shuttle mission. Using space exploration as a theme, the Center's highly acclaimed programs inspire students to pursue math, science, and technology studies, while at the same time helping them develop critical life skills.

The organization launched the Challenger Learning Center Network in 1987. Learning Centers use technology-rich educational environments to create hands-on and minds-on learning experiences. They offer a variety of programs, from mission simulations for students to professional development workshops for instructors. Each year, more than 300,000 students visit 37 Challenger Learning Center sites across the United States, Canada, and the United Kingdom.

Challenger Center for Space Science Education has developed the four flight scenarios offered at Challenger Learning Centers. *Voyage to Mars, Encounter Earth, Return to the Moon,* and *Rendezvous with a Comet* allow students to rev up their imaginations and transform themselves into astronauts, scientists, and engineers. All four scenarios, which meet or exceed National Science Education Standards, were developed with NASA engineers and scientists to ensure an authentic experience.

Mission scenarios and fees vary by location. Groups of up to 38 individuals are accepted on a space-available basis. Log on to **http://www.challenger.org** for the Learning Center nearest you.

CONTACT: Challenger Center for Space Science Education, 1250 North Pitt Street, Alexandria, VA 22314; Phone: (703) 683-9740 or 1-800-98-STARS; Fax: (703) 683-7546

Consortium for the Application of Space Data to Education (CASDE)

A wide variety of training opportunities for pre-service and in-service teachers are available through the ***Consortium for the Application of Space Data to Education (CASDE).*** This consortium was created to provide mechanisms to integrate NASA's extensive data holdings and advanced information system technologies into education. CASDE is dedicated to providing the educational community with vast amounts of NASA imagery, tools, educational resources, and interdisciplinary activities. CASDE tools, tutorials, a useful "building-block" curriculum structure, classroom ready posters, and interactive laboratory kits, have all been developed by the consortium to introduce the basics of interpret-

ing space imagery and incorporating potential applications of NASA data to the education community and other interested parties.

The leadership of CASDE comes from three organizations, including the University of Nebraska at Lincoln, Center for Advanced Land Management Information Technologies, the Jet Propulsion Laboratory, and the University of Nebraska at Omaha Office of Internet Studies. Through these three organizations, the CASDE staff offers a variety of periodic staff development opportunities for educators (both pre-service and in-service) and other professionals (such as resource managers), who are interested in gaining more information or training-related CASDE resources. For example, one-day introductory seminars are available that introduce participants to CASDE imagery resources, sample curriculum activities, and software. Weeklong workshops are also offered periodically to provide teachers and other professionals a more in-depth training in CASDE resources, image visualization tools, and lesson design. The workshops also assist teachers in developing curriculum specific to their classrooms. In addition to these shorter duration opportunities, several graduate courses, and extended independent study classes for graduate credit, are also available from the University of Nebraska at Omaha. Web-based training opportunities, called "Webshops" are also being developed by the consortium. Within all the training opportunities, educators are involved in a wide variety of "hands-on" activities to help support a strong base of CASDE resource awareness, experience, and classroom integration. Participants particularly gain valuable experience with new technology-based tools, such as DataSlate, which is a new technology that allows users to explore essentially infinite data sets and to simultaneously compare co-registered and geo-referenced sets of data. DataSlate is being developed by the Jet Propulsion Laboratory.

CASDE invites partnering with other organizations to help provide such teacher training opportunities in various locations, and actively seeks collaboration with teachers and other professionals who are interested in expanding CASDE curriculum efforts.

CONTACTS: Paul Clark, Office of Internet Studies, UNO, Omaha, NE, 68182-0163; Email: Paul_Clark@unomaha.edu

Rick Perk, University of Nebraska, Lincoln, 113 Nebraska Hall, Lincoln, NE 68588-0517; Email: rperk@tan.unl.edu

EarthKAM

http://www.earthkam.ucsd.edu/

EarthKAM enables students to explore and learn about Earth using images taken from the unique and powerful perspective of space. EarthKAM has accumulated a wealth of images, taken remotely by middle school students operating an electronic still camera flown in Earth orbit. These visible-light images show a diversity of regions and physical features, from every continent except Antarctica—all available on the educational, user-friendly, Web-based data system. Educational materials are also available online to help educators get started with the program and integrate working with images into their classrooms and curricula.

EarthKAM's main objectives are:

- To integrate Earth images with inquiry-based learning to enhance curricula in support of national and state education standards;
- To provide students and educators the opportunity to participate in a space mission and to develop teamwork, communication, and problem solving skills;
- To engage teams of students, educators, and researchers in collaborative investigations using remotely-sensed data; and
- To incorporate the active use of Web-based tools and resources in support of the learning process.

Educators for grades 5 through 12 are invited to use the EarthKAM images and materials available on the EarthKAM Web site. Middle schools also have the opportunity of applying to join the online EarthKAM Community. The community provides additional information and support for students and educators as they conduct collaborative, inquiry-based investigations based upon the images and their classroom studies. Details on the benefits of and requirements for joining the EarthKAM Community are available on the Web site.

EarthKAM is a collaboration among NASA, the University of California, San Diego, and TERC's Center for Earth and Space Science Education.

CONTACT: EarthKAM Coordinator, Center for Earth and Space Science Education, TERC, 2067 Massachusetts Ave, Cambridge, MA 02140; Phone: (617) 547-0430; Fax: (617) 349-3535; Email: EarthKAM_Coordinator@TERC.edu

Earth Science Component for Academic Professional Enhancement (ESCAPE)

http://www.ssec.wisc.edu/outreach/escape

Professional development opportunities in the Earth and space related sciences continue to be the area of greatest need for teachers in Wisconsin. This project is addressing the Earth system science professional development needs of upper elementary, middle and high school science teachers in Wisconsin and interested neighboring states by offering NASA's Classroom of the Future (COTF) online Earth system science course in conjunction with the GET-WISE project.

Through our existing distance learning project, GET-WISE (Geoscience Enhancement for Teachers—Wisconsin Initiative for Space Education), and in partnership with the Wisconsin Academy Staff

Development Initiative (WASDI), we will recruit teachers from around the state to participate in the online Earth system science course. This program will be facilitated by scientists/education specialists.

Project GET-WISE was developed to exploit the use of instructional technology to achieve two critical objectives. First to link teachers across Wisconsin through the use of distance learning tools. Second, to support teachers integrating current instructional technologies in the development of improved Earth system science curriculum that is hands-on, motivating, engaging and effective in addressing the Wisconsin State Science and Technology standards. The University of Wisconsin School of Education, will offer two graduate credits for each semester of participation in the GET-WISE Initiative and additional credit will be offered for participation in follow-up summer workshops to be conducted by WASDI at one of thirteen sites around the state.

CONTACT: Rosalyn A. Pertzborn, Research and Outreach Specialist, Office of Space Science Education—Space Science & Engineering Center, University of Wisconsin–Madison, 1225 W. Dayton Street, Madison, WI 53706; Phone: (608) 265-4160; Fax: (608) 262-5974

Earth Science Enterprise Research Program—University of Montana

The University of Montana (UM) provides a technology learning center for professional teacher training and teacher in-service, which brings remote-sensing and basic Geographic Information System (GIS) applications into the classroom. Using data products provided by UM's Numerical Terradynamic Simulation Group (NTSG) and supplementing ongoing educational programs, UM's learning center introduces the latest remote-sensing concepts to the next generation of science classrooms in Montana.

UM has developed an online, for credit, course program for pre-service and in-service education of the teachers of Montana, as well as the technical components to expand this program nationally and internationally. This project brings online Earth system science courses developed by the Center for Educational Technologies at Wheeling Jesuit University into the UM learning environment, presented through the e-College™ network.

Additionally, the project plans outreach and study of online courses for the Montana Native American population, working closely with several reservations across Montana. During the first year, the project will focus on one reservation and then expand over the three-year program to integrate operations in state and national hosts. Immediate impact is expected on Montana classrooms, with plans to explore the impact on Native American classrooms where special conditions and constraints may prevail. Project evaluation will delve deeply into the perceived meaning of scientific understandings in the Native American teaching corps and examine how these meanings are communicated in their classrooms.

CONTACT: John Kuglin, Director of Educational Outreach, or Wes Snyder, Research Professor of Education, University of Montana, James E. Todd Building, Missoula, MT 58912; Phone: (406) 243-6334; Fax: (406) 243-2047; Email: jkuglin@selway.umt.edu

Earth System Science Education Alliance (ESSEA)

http://www.cet.edu/essea

The Earth System Science Education Alliance (ESSEA), a partnership between the Institute for Global Environmental Strategies (IGES), the Center for Educational Technologies (CET) at Wheeling Jesuit University, through funding from NASA's Earth Science Enterprise, is an exciting and innovative professional development program.

ESSEA will support universities, colleges, and science education organizations in offering K–12 Earth system science (ESS) online graduate courses that have been developed within the CET at Wheeling Jesuit University for NASA's Earth Science Enterprise. The Earth system science courses use an innovative instructional design model, are delivered over the Internet, and feature student-centered, knowledge-building virtual communities. Successful proposers will participate in an intensive four-day training workshop to learn how to deliver the courses.

The ESS courses feature student-centered, knowledge-building communities in which groups of teacher/participants engage in problem solving, model building, and classroom activity design. A master teacher and/or an Earth system scientist, who act as guides and mentors throughout the 16-week courses, moderate participants. Participants' expectations are set through the use of rubrics for individual and group work as they learn new ESS content, become knowledgeable about new resources, develop confidence in the use of technology, and design new classroom activities.

IGES will award three-year grants to entities with unique and innovative proposals to facilitate and offer the Earth system science online courses developed and tested by CET. Plans are to issue new grants in early 2000, late 2000, and in 2001. A copy of the full proposal and guidelines is available at the ESSEA Web site—**http://www.cet.edu/essea**—or by mail at the address below.

CONTACT: Claudia Dauksys, ESSEA Program Associate, Institute for Global Environmental Strategies, 2111 Wilson Blvd., Suite 700, Arlington, VA 22201; Phone: (703) 875-8634; Fax: (703) 875-8635; Email: essea@strategies.org

Earth System Science Online Course: An Opportunity in Geography Education

http://www2.una.edu/geography

The goal of this project is to offer K–12 teachers of geography, Earth science, social studies and other related subjects the opportunity to increase their content knowledge in the field of Earth system science in a convenient, technology-enhanced environment. The objectives are to:

- Increase K–12 teachers' knowledge of, and experience in, Earth system science;
- Provide teachers in underserved areas of Alabama, the southeast and other areas an opportunity to take a graduate level class in Earth system science;
- Enhance K–12 teachers' use of the Web and source material available through various governmental, private industry and educational organizations;
- Offer pre-service education students the opportunity to increase their content knowledge in Earth system science, while trying a new delivery method; and
- Test and demonstrate the power of the Internet and World Wide Web as a complete delivery system mechanism for Earth system science instruction.

Admittance to the graduate program at the University of North Alabama is a requirement of participation. It is anticipated that the course will be offered starting with the fall semester 2000.

In addition to delivering the existing Earth system science online course that has been developed by the Center for Educational Technologies at Wheeling Jesuit University, the course will bring an additional focus on the use of the Essential Elements of the National Geography Standards.

CONTACT: Dr. William R. Strong, Box 5064, Department of Geography, University of North Alabama, Florence, AL 35632-0001; Phone: (256) 765-4218; Fax: (256) 765-4911; Email: wstrong@unanov.una.edu

Enhancement of the Global Systems Science Student Guide Series for the Digital Earth Initiative

Atmospheric and Environmental Research, Inc., Boston's Museum of Science, Lawrence Hall of Science in Berkeley, CA, and Logal.net will digitize and enhance the ***Global Systems Science (GSS) Student Guide Series*** for interactive use on the Internet and the ***Digital Earth Initiative.*** The GSS Student guide series, developed during the past eight years at the Lawrence Hall of Science, can be combined in various ways to create an interdisciplinary high school course. In the GSS approach students integrate the traditional disciplines to probe the interactions among the atmosphere, ocean, ice, solid Earth, and living organisms that shape Earth's evolution and its future. Students study the traditional disciplines, not as ends in themselves, but as tools for a scientific understanding of Earth as an integrated system. The course draws on a variety of disciplines to illustrate how scientists investigate the ways that human activities interact with Earth systems. The content and pedagogy of the Global Systems Science course reflects the four goals that lie at the heart of the National Science Education Standards:

- GSS starts with real-world societal issues selected to evoke interest, excitement, and an appreciation of the value of science.
- Through laboratory activities and discussions, students are given opportunities to investigate and apply the scientific processes and principles that inform each of the issues.
- Students are encouraged to discuss their changing perspectives as the course proceeds, and to think about how they can affect the outcome in each area of concern through personal decisions.
- Students are motivated to continue their study of technical fields as they encounter a wide diversity of role models featured in the GSS Student guides.

The nine-part GSS Student guide series will be digitized, not only by creating hypertext links between the documents, but by developing an educational software interface that creates organic, living documents connected to any data accessible on the Internet. Logal.net has developed revolutionary software that displays, overlays, and interacts with any Internet data source on one computer screen. Science, education, research, technology, and public policies will all be integrated and available for students, public planners, the media, and the general public to explore, analyze, and make decisions.

CONTACT: John Pickle, Staff Scientist for Education Development, Atmospheric and Environmental Research, Inc. (AER), 840 Memorial Drive, Cambridge, MA 02139-3771; Phone: (617) 349-2277; Fax: (617) 661-6479; Email: jpickle@aer.com

The Gaia Crossroads Project

The Gaia Crossroads Project is an innovative program using satellite remote sensing in K–12 classrooms. This progressive program captures the interest of elementary students and sustains their interest through high school. Using the imagery provided, students are able to study and interpret satellite images of their local communities. After the initial focus on the local environment, the program expands to include images of a broader geographic coverage-the Gulf of Maine and the North Atlantic for studying oceanography, weather satellite images for studying meteorology, and images of tropical rain forests for studying global ecosystems. The project provides ongoing teacher training and technical support.

The Gaia Crossroads Project's future plans include conducting a three-year pilot project in Maine to demonstrate that students can produce an accurate land use/land cover map of their state that will prove of value to state government. Another future plan is for a two-year pilot program to develop a new approach to a comprehensive study of the water cycle. Students and teachers will use NASA data and other imaging products to follow a drop of water from the time it falls as rain until it once again becomes a raindrop. The protocols, training modules, and strategies developed in these pilots would become models for students and teachers in other states.

The Gaia Crossroads Project Teachers Guidebook for Using Satellite Imagery in the Classroom and Community is available through Bigelow Laboratory. It contains background information on the project, a remote-sensing primer, hands-on tutorials, ideas for setting up the program in a classroom, over sixty activities written and classroom tested by teachers in the Gaia Crossroads Project, and an extensive listing of resources.

CONTACT: Cynthia B. Erickson, Project Director, The Gaia Crossroads Project, Bigelow Laboratory for Ocean Sciences, P.O. Box 475, McKown Point, West Boothbay Harbor, ME 04575-0475; Phone: (207) 633-9600; Fax: (207) 633-9641; Email: gaiaxroads@bigelow.org

Global Learning and Observations to Benefit the Environment (GLOBE)

http://www.globe.gov

GLOBE is a worldwide network of K–12 students who work under the guidance of GLOBE-trained teachers to make a core set of environmental observations at or near their schools and report their data via the Internet. GLOBE environmental measurements are in the following study areas: Atmosphere, Hydrology, Land Cover, Soils, Global Positioning System (GPS), and Seasons. Scientists use GLOBE data in their research and provide feedback to the students to enrich their science education. Each day, images created from the GLOBE student data sets are posted on the World Wide Web, allowing students and visitors to the GLOBE Web site to visualize the student environmental observations. Teachers and students from over 6,500 schools in over 80 countries participate in GLOBE.

An interagency team manages GLOBE, which includes NASA, the National Oceanic and Atmospheric Administration, the National Science Foundation, the Environmental Protection Agency, and the Departments of Education and State.

There is no cost to participate in the GLOBE Program. However, schools must support participation by one or more teachers to attend a GLOBE Training Workshop and make equipment available to students for taking measurements and Internet access for reporting their data.

CONTACT: GLOBE Program, 744 Jackson Place, Washington, DC 20503; Phone: (800) 858-9947; Email: info@globe.gov

The JASON Project

http://www.jasonproject.org/

The JASON Foundation engages students in science and technology, and motivates and provides professional development opportunities for teachers through the use of advanced interactive telecommunications. JASON expeditions, targeted for grades 4–10, are supported by extensive teacher training and award-winning curriculum and Internet program, and feature live, interactive broadcasts through robotics, fiber optics, television production, computer science, and satellite communications. JASON programs are broadcast to 36 Primary Interactive Network Sites (PINS) throughout the United States and the world. JASON also provides live broadcasts of expeditions directly to classrooms and through streaming video on the Internet. NASA PINS include Ames Research Center, Goddard Space Flight Center, and Johnson Space Center.

Programs focus on oceans, rainforests, extreme environments, volcanoes and exploration of inner and outer space. All programs focus on connecting students and teachers with researchers and scientists in the field.

The JASON Project is reasonably priced by unit for individual or school-wide participation. For more information on how to get involved, visit JASON on the Web at **http://www.jasonproject.org** or call 1-888-JASON-00.

CONTACT: JASON Foundation for Education, 395 Totten Pond Road, Waltham, MA 02451; Phone: (781) 487-9995; Fax: (781) 487-9999; Email: info@jason.org

The JMU DEVELOP Center—Digital Earth

The Digital Earth is a virtual representation of our planet that enables a user to explore and interact with the vast amounts of natural, cultural, and historical information being gathered about the Earth. The Digital Earth initiative brings together Federal Agencies, private and not-for-profit institutions, and other contributors to facilitate the development of the technology, standards, and content necessary for realization of the Digital Earth

The JMU DEVELOP Center focuses on student-oriented research that blends course work and capstone experiences, faculty and student investigations, and industrial experiences. Towards that end, the JMU DEVELOP Center provides:

- Student and teacher access to interagency data;
- Inspiration of individuals to learn about the Earth through center activities;
- Promotion of Digital Earth technology on a local, state, regional, national, and international level;

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- The "bridge" between public outreach and education, and Digital Earth technologies;
- Instructional videos and multimedia;
- Computer lab to complete educational activities;
- Virtual reality interfaces;
- NASA research and information; and
- Set of planned activities based on educational level.

JMU will offer a one-week digital Earth workshop for pre-service teachers and a small group of in-service teachers the third week of June 2000 at James Madison University.

CONTACT: James L. Barnes, James Madison University, Harrisonburg, VA 22807; Phone: (540) 568-3154; Fax: (540) 568-2747; Email: barnesjl@jmu.edu

Learning Technologies Project

http://education.nasa.gov/ltp

The NASA *Learning Technologies Project* (LTP) uses NASA's inspiring mission, unique facilities, and specialized workforce, along with the best emerging technologies, to promote excellence in America's educational system. LTP funds activities that deliver NASA mission content via the Internet and other technologies to foster reform and restructuring in math, science, computing, engineering, and technical education.

LTP promotes effective use of NASA information and knowledge for education and life-long learning by means of:

- **Education Outreach Centers.** NASA LTP Center projects breathe life and immediacy into curricula—incorporating technology to enhance learning and using technological advances to serve educational goals. Among the many NASA Center projects are the NASA Quest Learning Technologies Channel, which allows a multi-dimensional Web experience incorporating email, chat rooms, audio, video, synchronized graphics, and sometimes NASA Television to offer participants workshops, lectures, seminars, courses, and exciting live events around the world.
- **Leading Educators to Applications, Research and NASA-related Educational Resources in Science (LEARNERS) Projects.** The seven LEARNERS projects launched in late 1999 to enhance K–12 science, mathematics, technology, and geography education through Internet-based products derived from content on NASA's mission. These projects feature topics in Earth science, space science, and aerospace technology.
- **Legacy Projects.** Funded by LTP in the past are projects ranging from those emphasizing innovative public use of remote-sensing data, to those using Digital Library Technology, to those with an aeronautics focus in grades K–14.

CONTACT: Mark León, NASA ARC, MS 269-3, Moffett Field, CA 94035; Phone: (650) 604-6498; Email: mleon@mail.arc.nasa.gov

NASA Summer School for High Performance Computational Earth and Space Sciences

http://cesdis.gsfc.nasa.gov/

The NASA Goddard Space Flight Center's Earth and Space Data Computing Division (ESDCD) and the Universities Space Research Association (USRA) annually solicit applications from qualified graduate students to participate in an intensive summer lecture series in computational Earth and space sciences. The ESDCD provides comprehensive research and development support in data handling and computing for NASA Earth and space science research programs. Resident facilities include a 1024-processor Cray T3E, a Cray J90 cluster composed of three 32-processor Cray J90 systems, and several Beowulf-class systems (Beowulf is a class of inexpensive massively-parallel systems designed as a cluster of commodity PC's using LINUX). This program stems from ongoing activities that reflect NASA's desire to help train the next generation of Earth and space scientists in the development of computational techniques and algorithms for scalable parallel computers in support of the Federal High Performance Computing and Communications Program.

Approximately 15 students are selected annually to participate in the three-week program. The program aims to attract Ph.D. students in the Earth and space science disciplines whose present or future research requires large-scale numerical modeling on massively parallel architectures. Eligibility is normally limited to those Earth and space science students who are enrolled in U.S. universities and who have passed their Ph.D. qualifying exams. Because of NASA GSFC security regulations, citizens of certain prescribed nations may be ineligible. Students are given hands-on computer training and small group interaction experience. Experienced computational scientists present a series of lectures on advanced topics in computational Earth and space sciences, with emphasis on computational fluid dynamics and particle methods. Vendors present lectures on developing software for their massively parallel architectures. Both the Cray T3E and the Beowulf systems are available for use by the students.

Students receive a per diem and will be reimbursed for domestic transportation to and from Greenbelt, Maryland. Students are housed near Goddard Space Flight Center and transportation to and from Goddard each day is provided.

CONTACT: Georgia L. Flanagan, Program Coordinator, USRA/HPCP, Code 930.5, NASA Goddard Space Flight Center, Greenbelt, MD 20771; Phone: (301) 286-2080; Email: georgia@cesdis.usra.edu

National Workforce Development Education and Training Initiative

Building a strong work force to populate one of the fastest growing industries in the nation is one of the challenges facing NASA's Commercial Remote Sensing Program (CRSP) at Stennis Space Center. On October 1, 1999, CRSP, along with NASA's Education and University Affairs Office at Stennis, announced a national program that is designed to meet that challenge.

The national plan is based on the successful approach demonstrated by the Mississippi Model for ***Workforce Development Education and Training*** (WDET), currently being implemented by CRSP's Mississippi Space Commerce Initiative. As NASA's lead center for commercial remote sensing, Stennis introduced WDET in the state of Mississippi two years ago. WDET has been given the task of ensuring that a trained workforce will be available to populate the rapidly growing remote-sensing industry. The Mississippi Model and the Mississippi Department of Education launched a program, which when fully implemented, will bring remote-sensing technology to every Mississippi student by 2003. This program has been the focus of national attention, bringing education officials from around the nation to Mississippi to observe the schools involved. Spatial Information Centers have been established in all Mississippi Community Colleges and Universities are investigating remote-sensing courses for existing disciplines.

NASA, the US Department of Education, the US Department of Labor, the US Department of Agriculture, the US Department of Interior and the US Department of Defense will work together to ensure that all students are exposed to remote-sensing technology. Industries, colleges and universities will also be part of the network. Additionally, NASA will draw on its existing partnerships with the Smithsonian Institution, National Geographic, the Public Broadcasting Service and the Global Learning and Observations to Benefit the Environment program.

CONTACT: Brenda Pounds, Stennis Space Center, Building 1200, Stennis Space Center, MS 39529; Phone: (228) 688-3814; Fax: (228) 688-7528; Email: brenda.pounds@ssc.nasa.gov

NOVA Online Earth System Science Courses

CONTACT: Michael Odell, NOVA, University of Idaho, College of Education, Moscow, ID 83844-3082; Phone: (208) 885-6786; Fax: (208) 885-0560

Project SUN—Students Understanding Nature

http://sunshine.jpl.nasa.gov

NASA's Genesis Mission currently sponsors ***Project SUN*** as part of its outreach effort to instill knowledge in students about the natural links between the Earth and Sun. It is also carried out in partnership with the Astronomy and Physics Department and the College of Extended Learning, California State University, Northridge (CSUN). Project SUN is a component of the CSUN International Science Network (ISN).

Through Project SUN, secondary students all over the world are contributing to the long term, time resolved, monitoring of both visible and UV radiation on the Earth's surface. Data is usually transmitted to NASA's Jet Propulsion Laboratory (JPL) via the Internet. Participating schools purchase their own equipment, total cost about $600, not including the cost of a computer supplied by the school to use for the data logger. Schools agree to supply NASA JPL at least two days of data per week for a full school year. The equipment can be used the other three days for individual research projects such as investigation of the efficiency of different items of solar energy equipment, use of UV skin blockers, effects of enhanced UV radiation on plants, etc. It is hoped each school will integrate Project SUN as a continuing program, using the concept of a school research team, just as the school has established athletic teams.

The components of Project SUN are: 1) low cost, scientifically accurate instrumentation; 2) computer interfacing coupled with old computers such as the Apple IIE, Apple IIC, Macintosh and old IBM compatibles used as dedicated data loggers; 3) appropriate software and curriculum; and 4) a detailed operating strategy and a system of in-service teacher training. Part of this training is via the CSUN course Physics 595s, Solar Flux Detection, which is taught over the Internet by Dr. Gilbert Yanow.

Very careful, annual re-calibration of the commercial instruments and a continuing program of instrumentation quality control done in cooperation with the manufacturers, maintains the accuracy of the data.

CONTACT: Gilbert Yanow, NASA Jet Propulsion Laboratory, Mail Stop 264-370, 4800 Oak Grove Dr., Pasadena, CA 91109; Phone (818) 354-8060; Fax (818) 393-1392; Email: gilbert.yanow@jpl.nasa.gov

Scenario Based Learning: Inquiry for a Digital Earth

While text-based media can provide a wealth of information, retention of data and facts is significantly limited. In contrast, a graphical representation allows us to absorb billions of bits of data instantly, e.g. maps, images, photographs. Therefore multi-dimensional graphical representations will be the only method to fully tap the vast amounts of data being gathered. Although multi-dimensional graphical virtual worlds have being used for many applications, it has not yet being exploited for educational purposes. The objectives of this project are:

- Develop and test scenarios that utilize resources that will be available via Digital Earth. How will the Digital Earth network facilitate the goals of the individuals involved in a scenario? How will individuals use the available data?
- Investigate whether multi-dimensional graphical virtual worlds and the scenario-based learning strategy provide an effective learning environment. What would they learn? Are these worlds more appealing? What are the design criteria for these scenarios to be effective learning environments?
- Produce a low-resolution 3-D Earth with geo-referenced data, which could be accessible by high-end desktop machines. Could high-end desktop machines maximize the use of Digital Earth resources?
- Involve individuals of groups that have traditionally been underrepresented in Earth science in the creation and usage of Digital Earth resources.

First, a three-dimensional low-resolution Earth elevation map that could run on high-end yet affordable desktop machines will be created. Second, atmospheric science data, i.e., ozone, water vapor, sea surface temperature, precipitation, surface temperature, will be added to this Earth elevation map. Third, four scenarios will be played-out with undergraduate students to test their ability to learn and make high order decisions based on the knowledge acquired with these multi-dimensional virtual-world scenarios.

CONTACTS: Waldo Rodriguez, BESTLab/Chemistry, Norfolk State University, 700 Park Avenue, Norfolk, VA 23504; Phone: (757) 823-2381; Fax: (757) 823-9054; E-mail: waldo@vigyan.nsu.edu

S. Raj Chaudhury, BESTLab/Chemistry, Norfolk State University, 700 Park Avenue, Norfolk, VA 23504; Phone: (757) 823-2241; Fax: (757) 823-9054; E-mail: raj@vigyan.nsu.edu

Student's Online Atmospheric Research (SOLAR): A SAGE III Educational Outreach Program

http://arbs8.larc.nasa.gov/sage3/

The Stratospheric Aerosol and Gas Experiment III (SAGE III) will play a critical role in NASA's Earth Science Enterprise by monitoring the distribution of aerosols and trace gases in the upper atmosphere, from Earth orbit. The long-term data provided by SAGE III will enable atmospheric scientists to assess possible influences of human activities and natural events and the Earth climate system and other atmospheric processes such as ozone depletion. SAGE III is planned for launch in late 1999. Two additional SAGE III sensors are planned for launch within the next several years, one of which will be placed on the International Space Station. This combination of SAGE III instruments should provide critical measurements well into the next century.

The SAGE III outreach program has selected a project that will help students in grades 9–12 develop hands-on skills in working with scientific equipment. It will also give students experience in collecting, analyzing, and reporting scientific data. The project involves collecting atmospheric data using a small hand-held instrument, a sun photometer. Students can build a sun photometer from inexpensive parts available from electronics stores. This small hand-held device measures intensity of direct sun light, and can be used to determine attenuation of sun light caused by aerosols and gases in the Earth's atmosphere. The sun photometer is a simplified version of the satellite-based SAGE III in-strument, and the measurement concept is basically the same as that of SAGE III.

CONTACTS: David C. Woods, Mail Stop 475, NASA Langley Research Center, Hampton, VA 23681-0001; Phone: (757) 864-2672; Fax: (757) 864-2671; Email: d.c.woods@larc.nasa.gov

Susan C. Walters, Mail Stop 475, NASA Langley Research Center, Hampton, VA; Phone: (757) 864-5879; Fax: (757) 864-2671; Email: s.c.walters@larc.nasa.gov

University of Montana's Earth Observing System (EOS) Education Project

http://www.eoscenter.com

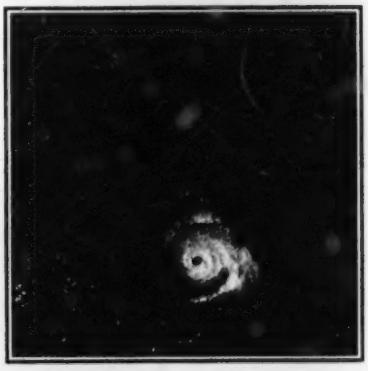
This project disseminates EOS mission imagery, supportive curriculum, and relevant programs to the K–16 education community. The *EOS Education Project* also provides training for the K–16 educational community in the interpretation, utilization, and relevancy of EOS mission imagery. These resources are delivered through a dynamic combination of online and onsite teacher workshops, Internet-based courses, national conferences, interactive map and image servers, and Earth system science content.

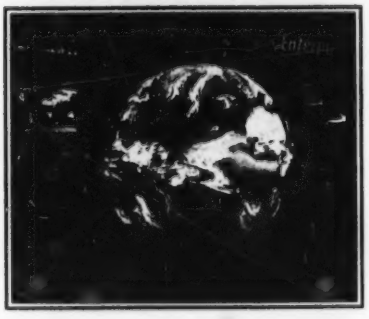
Distributed and classroom-based Geographic Information Systems (GIS) are used to assist teachers to obtain remote-sensing imagery and ancillary data for project-based learning. We investigate how EOS information can enhance existing NASA interdisciplinary curriculums that explore the diverse and changing landscapes of the world.

The EOS Education Project has assembled a team of education, technology, and resource specialists to serve the growing needs of the global environmental education community. The project has also established strategic alliances within the private and public sectors to advance state-of-the-art solutions for geographical information dissemination and education program development across local, regional, and global scales. The collective mission supports educator and student un-derstanding of complex global ecosystems and humans' role in affecting these systems.

CONTACT: Phone: 1-800-0411-0341; Email: umtonline@selway.umt.edu

INFORMAL EDUCATION





NASA's Earth Science Enterprise has begun to build its informal education program. Informal education projects provide opportunities outside formal school settings, where individuals of all ages, interests, and backgrounds can increase their appreciation and understanding of Earth system science and global climate change. These projects are conducted in collaboration with outside museums, universities, and other formal and informal education organizations.

The Dynamic Earth

http://www.discoverycube.org

Discovery Science Center is an interactive science center with over 100 hands-on exhibits augmented by educational programming and materials providing learning opportunities for students, teachers, and family audiences. ***The Dynamic Earth*** program includes:

- Resource materials and kits provide the classroom teachers with a set of hands-on materials that will enable the students to design and test experiments. The curriculum packet contains science content information, vocabulary list, a materials list, timeline for preparation and implementation, tips for managing the students or classroom during hands-on experiences, a bibliography of additional materials, and a collection of professional contacts.
- Teacher training program in the use of these materials and lesson plans. This six-hour training, along with the teacher's guide and kit will enable two to three weeks of classroom instruction.
- An interactive science presentation for the classroom or general public.
- Family science nights at the science center. These evenings will introduce families to the science programs presented in the schools. Families will observe science demonstrations, attend science lectures, interact with the hands-on exhibitry, such as an earthquake simulation room, an eight-foot free-standing tornado, and a kalliroscope that models the fluid dynamics of the ocean and/or the atmosphere.

Some of the concepts the participants in the Dynamic Earth program will investigate are:

- Plate tectonics and the changing patterns of land, sea and mountains on the Earth's surface;
- How the Sun's heating of the Earth's surface drives convection within the atmosphere and oceans, producing winds and ocean currents, leading to an understanding of global weather patterns and geographical distribution of marine and terrestrial organisms; and
- Human impact on the Earth's atmosphere, and in turn how the altered atmospheric conditions affect all life on Earth.

Interested parties should contact the Education Department or Group Bookings at (714) 542-2823.

CONTACT: Janet Yamaguchi, Vice President, Education, Discovery Science Center, 2500 North Main Street, Santa Ana, CA 92705; Phone: (714) 542-2823; Fax: (714) 542-2828; Email: jyamaguchi@discoverycube.org

Earth & Sky Broadcast Fellowships

http://earthsky.worldofscience.com

The *Earth & Sky* radio series, in cooperation with NASA Goddard Space Flight Center in Greenbelt, Maryland and the NASA Jet Propulsion Laboratory in Pasadena, California competitively selects one or more annual radio fellows each year to work in residence at a NASA field Center or other space research institution.

Earth & Sky and NASA select one or more science writers to be Fellows during the summer months. The Fellows travel first to Austin, Texas, to work with Earth & Sky for one week. Then Fellows travel to a selected host research institution to work with scientists for approximately six to seven weeks. At each institution, each Fellow will:

- Work with NASA scientists and Earth & Sky producers to identify newsworthy topics about NASA science.
- Gather information and record interviews with NASA scientists about these topics.
- Prepare and write scripts for radio programs on NASA Earth and Space Sciences.

The written scripts and recorded interviews will be sent back to Earth & Sky in Austin, for use as part of this nationally-syndicated radio series. Earth & Sky, which has been broadcasting nationally since 1991, is funded primarily by the National Science Foundation. Audience measurements in 1998 indicate that the radio series has four million listeners each week in the United States.

The deadline for submission of applications for the Fellowship is December 31 each year. Preference will be given to applicants with experience in writing for broadcast, but all applicants are welcome.

CONTACT: Mike Rhodes, P.O. Box 2203, Austin, TX 78768; Phone: (512) 477-4441; Email: mrhodes@earthsky.com

Earth Science Informal Science Education

http://museumearth.jpl.nasa.gov

The goal of this program is to understand how NASA Earth Science can best address the needs of informal educators, including museums, science centers, aquaria, zoos, periodicals, and youth groups. In 1999, NASA's Jet Propulsion Laboratory (JPL) worked with the Denver Museum of Natural History and 11 other museums to develop and conduct a survey of informal education priorities in Earth Science and interests in future programs.

Plans for 2000 include the development and implementation of programs identified in the survey, including Earth Science workshops and Digital Earth informal education partnerships.

CONTACT: Marguerite Syvertson, 4800 Oak Grove Drive, Mail Stop 183-335, Pasadena, CA 91109; Phone: (818) 354-6492; Fax: (818) 393-6546; Email: marguerite.syvertson@jpl.nasa.gov

Elderhostel: Earth's Intricate Balance

http://www.wm.edu/auxiliary/elderhos/index2.htm

Older adults can explore our world through this nontechnical, *Elderhostel* course, which examines the components of the Earth system, their interactions, and how human activity impacts upon them. NASA and select college faculty will enhance participants' understanding of our planet and its delicate balance through lectures and discussion. A field trip to the Virginia Institute of Marine Science of the College of William and Mary and intriguing visits to geological sites in the area are planned. This program is held once a year and is scheduled in 2000 for May 7–12, with applications due April 1, 2000. Program tuition is all-inclusive: the costs of rooms, meals, instruction and field trips are included.

CONTACT: Arlene S. Levine, Mail Stop 401, NASA Langley Research Center, 21 Langley Boulevard, Hampton, VA 23681-2199; Phone: (757) 864-3318; Email: A.S.Levine@larc.nasa.gov
or—William and Mary Elderhostel, Sue Smith, Director, 234 Jamestown Road, P.O.Box 8795, Williamsburg, VA 23187-8795; Phone: (757) 221-3644; Email: sesmit@facstaff.wm.edu

Electronic Theater Presentations

Large screen format digital theater presentations displaying new NASA Earth science data sets in high resolution are available to technical and non-technical audiences. Presentations demonstrate new information technology tools, techniques, and digital presentation approaches. Approximately 20 presentations are offered annually around the country and the world to audiences totaling 30,000 members of the international science and technology community. At least 3 months notice is preferred for scheduling.

CONTACT: Fritz Hasler or Barbara Summey, Code 912, NASA Goddard Space Flight Center, Greenbelt, MD 20771; Phone: (301) 614-6270; Email: hasler@agnes.gsfc.nasa.gov

Eyes on Earth

The Oregon Museum of Science and Industry (OMSI) proposes to build an interactive traveling exhibition consisting of 10 and 15 exhibit units that will focus on NASA Earth Observation System (EOS) missions. During its eight-year tour, the approximately 2,000-square foot *Eyes on Earth* is projected to visit twenty-four museums around the nation and be viewed by more than four million people.

This exhibition is intended to present science center visitors with a suite of hands-on exhibits that will convey the value of observing the Earth from space as well as the means by which scientists

are studying our home planet. The conceptual approach is to highlight the various EOS missions as they help us understand the Earth. This would involve a blending of a variety of research areas such as meteorology, oceanography, biology, and atmospheric science. The exhibit concepts represent NASA missions that support these fields. The exhibits will be interactive, providing opportunities for the visitor to learn about EOS at their own ability level and pace.

A teacher's guide to the exhibit, available on the World Wide Web and in hard copy, will be produced to support the exhibition. OMSI has developed teacher's guides for many of its traveling exhibitions, and has extensive experience in producing educational materials on the World Wide Web.

CONTACT: Raymond J. Vandiver, Ph.D., Science Director, Oregon Museum of Science and Industry, 1945 SE Water Avenue, Portland OR 97214-3354; Phone: (503) 797-4643; Fax: (503) 797-4500; Email: Ray.Vandiver@omsi.edu

Forces of Change

Forces of Change is a comprehensive program being developed by the Smithsonian's National Museum of Natural History, through funding from NASA and other donors, to explain the geological, environmental, and historical processes that have shaped our world. It will consist of a permanent exhibit in the Museum, a traveling exhibit, publications, interactive computer programs, and public programming which will include a lecture series and electronic classroom courses.

The cornerstone of the *Forces of Change* program is a permanent exhibit in the National Museum of Natural History scheduled to open early in 2001. The 5,400 sq. foot display will examine the forces of change that have shaped and sustained the Earth since the beginning of geologic time. The goal of the exhibit will be to inform visitors about the history and present condition of our environment as the world prepares to enter the 21st century. The exhibit will be a marriage of traditional and high-tech approaches to learning about Earth systems and managing our precious natural resources. Upon entering, visitors will encounter the Earth Systems Monitoring Station, a multi-media display of remote-sensing imagery, real-time data links, historic evidence and other techniques that demonstrate how the Earth is affected by geological, environmental, and human changes, and how all of these processes are interconnected. A rotating case study area will highlight regional themes, changing every two years and allowing visitors to learn about how global forces have affected specific parts of the planet. The inaugural section on Antarctica will illustrate how the relatively pristine landscape of this remote continent serves as a living laboratory for scholars around the world interested in studying the processes of global change through geologic time. Other regional studies under consideration are the North American Grasslands, Hawaii, the Chesapeake Bay and Amazonia.

In addition to the exhibit, *Forces of Change* will be available in a variety of formats—videos, CD-ROMs, and posters—for use in: classrooms, municipal buildings, malls, and airports. A traveling exhibit on agriculture in the North American grasslands will circulate through libraries nationwide and a richly illustrated coffee-table book, published by National Geographic, will further articulate the programs themes.

CONTACT: Barbara Stauffer, National Museum of Natural History, Office of Exhibits, 10th and Constitution, Washington, DC 20560-0101; Phone: (202) 357-2377; Fax: (202) 786-2567; Email: stauffer.barbara@nmnh.si.edu

Global Links

The National Museum of Natural History's *Forces of Change* (see previous listing) program will collaborate with NASA's Goddard Space Flight Center's Visualization Analysis Lab (VAL) to design an exhibit about Earth system science, called ***Global Links.*** The exhibit will advance the public's understanding of Earth system science by combining NASA's expertise in space-based observations with the Museum's renowned collections and expertise in object-based science education. By relating museum specimens with remote-sensing visualizations, the exhibit interpretation will capitalize on the unique capability of space-based imagery to present a global perspective of the Earth and the unique appeal of seeing and interacting with tangible evidence of the Earth's dynamics and history.

With this prototype, the *Forces of Change* team hopes to begin dialogues with outside museums interested in Global Links displays of their own. After installation of the Global Links exhibit at the Museum, a "kit" will be assembled and made available to interested museums following the installation of the Global Links exhibit at the Museum. Contents of the "kit" will include: software for computer interactives, exhibit script, design drawings, fabrication blueprints, installation guidelines, technical specifications, slides and transparencies of appropriate images, a Web link, resource lists, and other helpful material as it is identified during the museum assessment and exhibit development process. Also, survey and field test results will be assembled, duplicated, and made available to NASA and interested museums.

CONTACT: Barbara Stauffer, National Museum of Natural History, Office of Exhibits, 10th and Constitution, Washington, DC 20560-0101; Phone: (202) 357-2377; Fax: (202) 786 -2567; Email: stauffer.barbara@nmnh.si.edu

GSFC Earth Sciences Directorate Scientific and Educational Endeavors (SEE)

http://See.gsfc.nasa.gov/

SEE focuses on enabling the use of NASA Earth science information and data for formal and informal education. This program develops educational products for high school and undergraduate educators and for students at these levels. It also works with organizations and individuals involved in informal education throughout the U.S. to jointly produce useful educational and public awareness materials that utilize NASA's Earth science knowledge and expertise.

CONTACTS: Blanche Meeson, NASA Goddard Space Flight Center, Earth Sciences Directorate, Code 900, Greenbelt, MD 20771;
Email: bmeeson@see.gsfc.nasa.gov

Carla Evans, Goddard Space Flight Center, Earth Sciences Directorate, Code 900, Greenbelt, MD 20771;
Email: cevans@see.gsfc.nasa.gov

Learning Technologies Project

http://education.nasa.gov/ltp

The NASA *Learning Technologies Project* (LTP) uses NASA's inspiring mission, unique facilities, and specialized workforce, along with the best emerging technologies, to promote excellence in America's educational system. LTP funds activities that deliver NASA mission content via the Internet and other technologies to foster reform and restructuring in math, science, computing, engineering, and technical education.

LTP promotes effective use of NASA information and knowledge for education and life-long learning by means of:

- **Education Outreach Centers.** NASA LTP Center projects breathe life and immediacy into curricula—incorporating technology to enhance learning and using technological advances to serve educational goals. Among the many NASA Center projects are the NASA Quest Learning Technologies Channel, which allows a multi-dimensional Web experience incorporating email, chat rooms, audio, video, synchronized graphics, and sometimes NASA Television to offer participants workshops, lectures, seminars, courses, and exciting live events around the world.
- **Leading Educators to Applications, Research and NASA-related Educational Resources in Science (LEARNERS) Projects.** The seven LEARNERS projects launched in late 1999 to enhance K–12 science, mathematics, technology, and geography education through Internet-based products derived from content on NASA's mission. These projects feature topics in Earth science, space science, and aerospace technology.
- **Legacy Projects.** Funded by LTP in the past are projects ranging from those emphasizing innovative public use of remote-sensing data, to those using Digital Library Technology, to those with an aeronautics focus in grades K–14.

CONTACT: Mark León, NASA ARC, MS 269-3, Moffett Field, CA 94035;
Phone: (650) 604-6498;
Email: mleon@mail.arc.nasa.gov

Museums Teaching Planet Earth

http://earth.rice.edu/mtpe/mtpe.html

Special museum elements for presenting Earth science data to the public have been developed by this project, which is developed and managed by Rice University and the Houston Museum of Natural History, under NASA sponsorship. Each product is fully tested and will be available for application at schools and museums around the nation. The first, *Earth Forum*, is a series of simulation modules, which can be used either in exhibit mode or as problem-solving simulators for groups of students. The modules feature one continent and one related resource (e.g. fresh water for North America); Earth- and space-based imagery and data are used to show changes on Earth. Currently, more than 60 museums around the country are enrolled as subscribers, with a commitment to share special programming with their audiences.

CONTACT: Patricia Rieff, Rice University;
Email: Rieff@rice.edu

NASA-National Park Service Partnership Agreement

NASA's Goddard Space Flight Center and the National Park Service want to improve public awareness and appreciation of science. They have shared expertise in data visualization and displays and potential use of remote-sensing data for natural resource management; linked similar web site topics from each organization; developed interpretive styles for technical and scientific information; participated in professional association and community events; and shared training and opportunities to communicate to broad and diverse audiences. The partnership has strengthened and made richer each organization's efforts, with visible results in the majority of the 370 National Parks.

CONTACT: Janet Ruff, Mail Stop 130.0, NASA Goddard Space Flight Center, Greenbelt, MD 20771;
Phone: (301) 286-8955

EARTH SCIENCE ENTERPRISE EDUCATION PRODUCTS

A listing of ESE education materials is provided is this section. Unless noted, the following materials are available through the NASA Educator Resource Center (ERC) Network. Many products are also noted as available over the Internet or from NASA Central Operation of Resources for Educators—**http://core.nasa.gov**—which distributes materials to teachers for a shipping and handling charge, nationally and internationally. Please see page 75 for information about NASA CORE and pages 75–76 for information about the NASA ERCs.

CLASSROOM ACTIVITIES/ CURRICULUM MATERIALS

ELEMENTARY

Echo the Bat

http://imagers.gsfc.nasa.gov/

The ***Adventure of Echo the Bat*** is a program with both online and classroom components. The first unit, Understanding Light, provides a foundation for remote sensing and introduces the electromagnetic spectrum. The unit on Remote Sensing includes the Adventure of Echo the Bat, which is an interactive Web site allowing students to follow Echo the Bat as he migrates through Arizona. The adventure offers a directed and investigative approach to how land features look from space, what the colors mean in a Landsat image, and an introduction to identifying habitats in a false color Landsat image. Students go on to identify features in other satellite images using both images off the Web site and other textual resources. A unit follows on biodiversity covering topics such as food chains, food webs and the Nature Mapping program. The site is supported with a teacher's guide that includes lesson plans, classroom activities, and reproducibles. The units can also be utilized outside the program as supplemental activities within a required curriculum. All materials are available free on the Web.
Recommended level: Grades 5–8.

Echo the Bat Pop-Up Book

http://imagers.gsfc.nasa.gov/k-4/index.html

This picture book of *Echo the Bat* teaches the concepts of remote sensing throughout a story of a young bat lost in Arizona. Pop-up images are incorporated into the satellite images to assist the child in recognizing land features narrated in the story. The book is accompanied by a set of activities that reinforce four basic themes or concepts fundamental to the interpretation of satellite imagery: perspective, shape and pattern, color, and texture. Activities and activity sheets are also provided on a companion Web site: **http://imagers.gsfc.nasa.gov/k-4/index.html.** Available from NASA CORE Spring 2000.
Recommended level: K–4.

Exploring Earth from Space: Lithograph Set and Instructional Materials

LS-1999-05-001-HQ

http://spacelink.nasa.gov/products/

Shuttle astronauts and the EarthKAM program (see page 4) provide photos of our planet from the unique perspective of Earth orbit. They are an incredible resource that can enhance your student's studies of Earth and space science, geography, social studies, mathematics, and educational technologies. This lithograph set contains an educators guide, student information and worksheets, and several Earth photos taken from the Space Shuttle. Available online at NASA Spacelink or from your NASA ERC (see pages 75–76 for a listing of ERCs).
Recommended level: Grades 3–12.

Exploring the Environment

http://www.cotf.edu/ete

Online, problem-based modules developed by NASA's Classroom of the Future for K–4, 5–8, and 9–12 teachers and students. Modules address events such as volcanoes, hurricanes, dinosaur extinction theories, deforestation, endangered species, and global change. Use of NASA remote sensing images is a feature of the site—with tutorials about how to analyze Landsat images with NIH Image.
Recommended level: K–12.

From a Distance: An Introduction to Remote Sensing/GIS/GPS

http://education.ssc.nasa.gov/ltp/

This WWW site was developed and is maintained by NASA John C. Stennis Space Center. It includes lesson plans on remote sensing for grades K–3, 4–8, and 9–12 that were developed by professional educators, as well as links to related education resources.
Recommended level: K–12.

Our Mission to Planet Earth: A Guide to Teaching Earth System Science, 1994

http://spacelink.nasa.gov/products/Our.Mission.to.Planet.Earth/

Provides hands-on activities and information related to studying the Earth system. Its primary goal is for children to become familiar with the concept of cycles and to learn that some human activities can cause changes in their environment. A PDF file of this document can be downloaded from the WWW site listed.
Recommended level: Grades K–3.

MIDDLE SCHOOL

Echo the Bat

http://imagers.gsfc.nasa.gov/

The ***Adventure of Echo the Bat*** is a program with both online and classroom components. The first unit, Understanding Light, provides a foundation for remote sensing and introduces the electromagnetic spectrum. The unit on Remote Sensing includes the Adventure of Echo the Bat, which is an interactive Web site allowing students to follow Echo the Bat as he migrates through Arizona. The adventure offers a directed and investigative approach to how land features look from space, what the colors mean in a Landsat image, and an introduction to identifying habitats in a false color Landsat image. Students go on to identify features in other satellite images using both images off the Web site and other textual resources. A unit follows on biodiversity covering topics such as food chains, food webs and the Nature Mapping program. The site is supported with a teacher's guide that includes lesson plans, classroom activities, and reproducibles. The units can also be utilized outside the program as supplemental activities within a required curriculum. All materials are available free on the Web.
Recommended level: Grades 5–8.

Exploring Earth from Space: Lithograph Set and Instructional Materials

LS-1999-05-001-HQ

http://spacelink.nasa.gov/products/

Shuttle astronauts and the EarthKAM program (see page 4) provide photos of our planet from the unique perspective of Earth orbit. They are an incredible resource that can enhance your student's studies of Earth and space science, geography, social studies, mathematics, and educational technologies. This lithograph set contains an educators guide, student information and worksheets, and several Earth photos taken from the Space Shuttle. Available online at NASA Spacelink or from your NASA ERC (see pages 75–76 for a listing of ERCs).
Recommended level: Grades 3–12.

Exploring the Environment

http://www.cotf.edu/ete

Online, problem-based modules developed by NASA's Classroom of the Future for K–4, 5–8, and 9–12 teachers and students. Modules address events such as volcanoes, hurricanes, dinosaur extinction theories, deforestation, endangered species, and global change. Use of NASA remote sensing images is a feature of the site—with tutorials about how to analyze Landsat images with NIH Image.
Recommended level: K–12.

From a Distance: An Introduction to Remote Sensing/GIS/GPS

http://education.ssc.nasa.gov/ltp/

This WWW site was developed and is maintained by NASA John C. Stennis Space Center. It includes lesson plans on remote sensing for grades K–3, 4–8, and 9–12 that were developed by professional educators, as well as links to related education resources.
Recommended level: K–12.

Glacier Power

http://www.asf.alaska.edu:2222/

This 1997 CD-ROM, is a curriculum supplement module on the topic of glaciers that was developed in cooperation with NASA by the Alaska Synthetic Aperture Radar Facility (ASF) at the University of Alaska, Fairbanks and in cooperation with the Fairbanks North Star Borough School District and the University of Alaska Fairbanks, School of Education.

The guide includes information on glaciers and their importance to climate studies; lesson plans; student review exercises, activities, and projects; and resources such as glacier imagery, satellite imagery, illustrations, diagrams, and more. Available online at (see Web site above) or on CD-ROM from NASA CORE (Item #400.0-89).

Recommended level: Grades 4–6.

Ocean Expeditions: El Niño

http://www.teachtsp.com/products/productdetail.asp?PS=OEXNIN

This CD-ROM was developed by Planet Earth Science through support from NASA. ***Ocean Expeditions*** engages students in a journey where they must navigate their own ship, operate modern research tools, and manipulate satellite and climate model data to investigate and help predict El Niño—one of our planet's largest global climactic disruptions. Distributed by Tom Snyder Productions.

Recommended level: Middle school.

Visit to an Ocean Planet

http://topex-www.jpl.nasa.gov/education/cdrom.html

Interactive, educational CD-ROM that reveals the importance of our oceans to global climate and life. Allows users to explore the Gulf of Mexico with satellite data, investigate the 1997–98 El Niño, discover "what's up" with Earth-orbiting satellites, and learn about the research activities of real life oceanographers. The curriculum background materials are arranged in the context of widely accepted teaching themes. The CD-ROM also highlights results from NASA's TOPEX/POSEIDON satellite. Available from NASA CORE (Item #400.0-92).

Recommended level: Grades 5–12.

HIGH SCHOOL

Arctic Observatory/Sea Ice in the Polar Regions

Developed by the Consortium for International Earth Science Information Network (CIESIN) through sponsorship by the Office of Naval Research and in cooperation with NASA GSFC. The ***Arctic Observatory*** includes a teacher's guide and interactively deals with Arctic phenomena and processes, allowing students to ask and answer questions about interrelationships between several physical aspects of the Arctic system. ***Sea Ice in the Polar Regions*** is a presentation by NASA Goddard Space Flight Center scientist Claire Parkinson, which describes sea ice classification, observation and climate impacts. Both resources are available on one CD-ROM from NASA CORE (Item #400.0-90); they can also be downloaded at: **http://www.usra.edu/esse/learnmod.html.**

Recommended level: High school–adult.

Discover Earth: Earth as a System

http://www.strategies.org

Discover Earth classroom materials were developed during a series of teacher workshops sponsored by NASA and implemented by the Institute for Global Environmental Strategies in collaboration with the Department of Meteorology, University of Maryland, College Park, and the Earth and Mineral Sciences Environmental Institute, The Pennsylvania State University. This module examines the Earth system and includes: Key Concepts and Terms; Resources; Background for Teachers; and Classroom Investigations.

Recommended level: Grades 9–12.

Exploring Earth from Space: Lithograph Set and Instructional Materials

LS-1999-05-001-HQ

http://spacelink.nasa.gov/products/

Shuttle astronauts and the EarthKAM program (see page 4) provide photos of our planet from the unique perspective of Earth orbit. They are an incredible resource that can enhance your student's studies of Earth and space science, geography, social studies, mathematics, and educational technologies. This lithograph set contains an educators guide, student information and worksheets, and several Earth photos taken from the Space Shuttle. Available online at NASA Spacelink or from your NASA ERC (see pages 75–76 for a listing of ERCs).

Recommended level: Grades 3–12.

Exploring the Environment

http://www.cotf.edu/ete

Online, problem-based modules developed by NASA's Classroom of the Future for K–4, 5–8, and 9–12 teachers and students. Modules address events such as volcanoes, hurricanes, dinosaur extinction theories, deforestation, endangered species, and global change. Use of NASA remote sensing images is a feature of the site—with tutorials about how to analyze Landsat images with NIH Image.

Recommended level: K–12.

From a Distance: An Introduction to Remote Sensing/GIS/GPS

http://education.ssc.nasa.gov/ltp/

This WWW site was developed and is maintained by NASA John C. Stennis Space Center. It includes lesson plans on remote sensing for grades K–3, 4–8, and

9–12 that were developed by professional educators, as well as links to related education resources.
Recommended level: K–12.

Global Systems Science (1998)

Consists of interdisciplinary course materials developed by the Lawrence Hall of Science, through funding from the Department of Energy. The Global Systems Science Guides are available from NASA CORE as part of the Earth Science Middle School/Secondary Publication Packet (002.2-20P). (NOTE: Print materials in this packet are subject to change without notice.).
Recommended level: Grades 9–12.

SkyMath: Mathematics for a Blue Planet

http://www.unidata.ucar.edu/staff/blynds/Skymath.html

The University Corporation for Atmospheric Research (UCAR) received funding from the National Science Foundation to prepare ***SkyMath,*** a set of middle school mathematics modules incorporating weather data. SkyMath requires teachers and students to acquire and use current environmental and real-time weather data in ways that embrace the dynamic and the uncertain natures of these data, in order to promote the teaching and learning of significant mathematics, consistent with the standards set by the National Council of Teachers of Mathematics. The SkyMath modules may be freely downloaded from the Internet.
Recommended level: Grades 5–8.

Spaceborne Imaging Radar: Seeing the Earth in a New Way (1995)

Contains radar images of sites around the world as seen before and during the SIR-C missions of 1994. The CD-ROM contains handheld photographs from the Space Shuttle, QuickTime movies from the missions, and photographs from the ground. Using captivating examples such as the mountain gorilla habitats of Rwanda, a radar-generated flyby of the Galapagos Islands, the discovery of the Lost City of Ubar in the Arabian desert, and many others, the CD-ROM puts our Earth at students' fingertips. Teachers may use the CD-ROM in many ways, from activities as simple as viewing pictures or as complicated as performing science experiments with real data taken from Earth orbit. Students can learn about imaging radar through the structured lesson plans or think up their own experiments and analyze radar image data from the SIR-C missions. Available from NASA CORE (Item #400.0-75).
Recommended level: Grades 5–12, undergraduate.

Virtual Vacationland

http://www.bigelow.org/virtual/

Virtual Vacationland is a resource tool to help elementary and secondary teachers and students find and use Earth science data and information on the Internet. Content is arranged by science topic. Each topic has a preview page that summarizes the material. Each topic also has 2 to 5 detail pages, which show where to access online data and what the data mean. The site includes over 40 hands-on activities available on the following science topics, with new topics being added as the site grows: Land Topography; Ocean Bathymetry; Coastal Tides; Ocean Buoy Data; Ocean Temperature; Weather and Climate; and Watersheds and Rivers.
Recommended level: Elementary–secondary.

Visit to an Ocean Planet

http://topex-www.jpl.nasa.gov/education/cdrom.html

1998, interactive, educational CD-ROM that reveals the importance of our oceans to global climate and life. Allows users to explore the Gulf of Mexico with satellite data, investigate the 1997–98 El Niño, discover "what's up" with Earth-orbiting satellites, and learn about the research activities of real life oceanographers. The curriculum background materials are arranged in the context of widely accepted teaching themes. The CD-ROM also highlights results from NASA's TOPEX/POSEIDON satellite. Available from NASA CORE (Item #400.0-92).
Recommended level: Grades 5–12.

BOOKMARKS

The following bookmarks are examples of resources available from your local NASA Educator Resource Center (ERC). See pages 75–76 for a list of NASA ERCs.

Ozone
ET-1998-12-005-HQ

Biomass Burning
ET-1998-12-008-HQ

Volcanic Aerosols
ET-1998-12-006-HQ

Clouds
ET-1998-12-007-HQ

Human and Natural Impacts on the Earth
ET-1998-12-004-HQ

Urban Heat Island Bookmark
NP-1999-03-30-MSFC

LITHOGRAPHS WITH CLASSROOM ACTIVITIES

Lithographs contain a color image (e.g., satellite image, artist's rendition of a spacecraft or instrument, etc.), with additional information and classroom activities or discussion questions. The following are examples of lithographs available from your local NASA Educator Resource Center (ERC) or on NASA Spacelink: **http://spacelink.nasa.gov/products/.** See pages 75–76 for a list of NASA ERCs.

1997–1998 El Niño Lithograph
LG-1998-05-004-GSFC
Exploring Earth from Space
LS-1999-05-001-HQ
First Image of the Global Biosphere
Hql-325
Nimbus-7 TOMS Images: The Eight Marches
Hql-366
Nimbus-7 Ocean Ice Maps
Hql-319.1
Understanding Our Changing Planet
HqL-430
Water Is a Force of Change
Hql-401

NASA FACTS: EARTH SCIENCE ENTERPRISE SERIES

NASA Facts are educational brochures that provide general information and background on NASA-related missions, research topics, and activities. The *NASA Earth Science Enterprise Series* was produced in an effort to educate the general public concerning some of the major issues and the natural phenomena that scientists are studying using NASA Earth science data. The series is available online at: **http://eospso.gsfc.nasa.gov/eos_homepage/misc_html/nasa_facts.html.**

Ozone: What it is, and why do we care about it?
NF-198, December 1993
Clouds and the Energy Cycle
NF-207, January 1994
El Niño
NF-211, February 1994
Global Warming
NF-222, March 1994
Biosphere
NF-223, March 1994
Tropical Deforestation
FS-1998-11-120-GSFC
NASA Earth Science Enterprise Images and Video via the World Wide Web
FS-1998-02-007-GSFC, November 1998

POSTERS

Rise and Fall of the 97–98 El Niño as Tracked by the TOPEX/POSEIDON

EW-1998-11-004-JPL
http://topex-www.jpl.nasa.gov/education/el-nino-poster.html

Color satellite images from NASA's *TOPEX/POSEIDON* mission illustrate this poster, which tracks the *1997–98 El Niño.* The reverse side of the poster contains black and white, reproducible pages with information and classroom activities. Information and classroom activities contained on the poster are available in PDF format at the Web site listed above.

Earth Science Enterprise Poster

http://eospso.gsfc.nasa.gov/eos_homepage/eseposter.html

This information-loaded poster gives examples of Earth science data that have been retrieved from satellites, the real world problems the data has helped to solve, and information on the various missions that comprise NASA's *Earth Science Enterprise.* This is a double-sided, 35 inch by 24 inch poster.

Earth Observing System (EOS) Science Poster Series

http://eospso.gsfc.nasa.gov/eos_posters/posters_toc.html

The set includes the following seven posters: Cloud Radiative Effects; Global Ice & Sea Level Changes; Impact of Volcanoes; Vegetation & Hydrology Changes; Ozone Depletion; Ocean Processes; and Greenhouse Effect.

SLIDE SETS

The following 35mm slide sets are available for purchase from NASA CORE: **http://spacelink.nasa.gov/CORE/CORE_Home.html.** For more information about ordering materials from NASA CORE, please see page 75.

Earth/Space Science Slide Set for Educators

Designed to provide educators with some of the most-recent, space-based observations NASA has obtained in the area of Earth system science. 122 slides and background information are provided on the following themes that are considered of primary importance to Earth system science research: Clouds and Radiation; Ocean Productivity, Circulation, and Sea-Air Exchange; Greenhouse Gases; Changes in Land Use, Land Cover, Primary Productivity, and the Water Cycle; The Role of the Polar Ice Sheets and Sea Level; Ozone Depletion; and the role of Volcanoes in Climate Change. The package is available from NASA CORE, Item #100.0-47; also available online at: **http://eospso.gsfc.nasa.gov/eos_edu.pack/toc.html**
Recommended level: Grade 9–Adult.

The Ultimate Field Trip—An Astronaut's View of Earth

Astronaut Kathy Sullivan's account of her observations of the Earth from orbit. Dr. Sullivan writes about the enormous beauty and wonder of the Earth that varies from the regional, e.g., the Great Lakes, the Gulf of Mexico, and the Atlantic coastline; to the amazing detail found in cities, airports, and rivers. The brochure with 24 slides can be ordered from NASA CORE, Item #100.0-57.
Recommended level: Elementary–adult.

U.S. Geography: Space Shuttle Slide Sets

Slide sets of Space Shuttle photography for different areas of the United States, including: East Coast States from New England to Florida (CORE #100.0-49); Appalachian Mountains, Ohio River Valley, and Great Lakes (CORE #100.0-50); Great Plains States and Mississippi River Valley (CORE #100.0-51); Rocky Mountains and Southwest States (CORE #100.0-52); West Coast States, including Alaska and Hawaii (CORE #100.0-53); and U.S. Cities (CORE #100.0-54). Each slide set contains a selection of photos taken by astronauts and includes 20 slides with a brief descriptor (with the exception of U.S. Cities, which contains 60 slides.) Available from NASA CORE.
Recommended level: Elementary–adult.

Volcanoes of Hawaii and the Planets

Includes 20 slides with descriptions. Com-pares landforms in Hawaii and on the planets. Prepared by Dr. Peter Mouginis-Mark for the Hawaii Space Grant Consortium. NASA CORE Item #100.0-41.
Recommended level: High school–adult.

VIDEOTAPES

The following are selected videotapes related to NASA's Earth Science Program, which are available for purchase from NASA CORE: **http://core.nasa.gov.** For more information about ordering materials from NASA CORE, please see page 75.

Blue Planet (1990)

Filmed by astronauts from five Space Shuttle missions. This IMAX film dramatically reveals the forces affecting the Earth's ecological balance: volcanoes, hurricanes, earthquakes, and, ultimately, humankind. NASA CORE Item #002.2-15V. Length: 42:00.
Recommended level: Grade 4–adult.

Glacier Bay, Alaska, from the Ground, Air and Space (1996)

Brings glaciers to life with nine spectacular "fly-bys" of scenic rides over 3-dimensional glaciers, live video footage of ice fronts calving into the sea, and dramatic picture sequences of historical and satellite data, and shows how a NASA glaciologist has learned about glaciers and how their formation could be related to climate change. NASA CORE Item #002.2-16V; also available online at: **http://sdcd.gsfc.nasa.gov/GLACIER.BAY/glacierbay.story.html.** Length: 13:15.
Recommended level: Grade 5–adult.

Liftoff to Learning: The Atmosphere Below (1990)

Illustrates how changes in the Earth's atmosphere are investigated from outer space onboard the Space Shuttle using the ATLAS-1 experiment. Space Shuttle astronauts explain the questions scientists seek to answer by studying the Earth's atmosphere from space. Experiments discussed in this videotape focus on infrared detection of atmospheric remnants from volcanic eruptions, ozone concentration levels, and incoming solar ultraviolet radiation in respect to global warming. Includes a video resource guide for teachers. NASA CORE Item #002.2-14V. Length: 16:00.
Recommended level: Grades 5–12.

SunSplash (1997)

Explains ozone depletion, using computer graphics and animation. The educational narrative explains how ozone in the stratosphere protects us from ultraviolet radiation and demonstrates how chlorofluorocarbons (CFCs) cause destruction of the Earth's protective ozone layer. NASA CORE Item #002.2-18V. Length: 7:52.
Recommended level: Grades 9–12.

CD-ROMS

Arctic Observatory/Sea Ice in the Polar Regions

Developed by the Consortium for International Earth Science Information Network (CIESIN) through sponsorship by the Office of Naval Research and in cooperation with NASA GSFC. The ***Arctic Observatory*** includes a teacher's guide and interactively deals with Arctic phenomena and processes, allowing students to ask and answer questions about interrelationships between several physical aspects of the Arctic system. ***Sea Ice in the Polar Regions*** is a presentation by NASA Goddard Space Flight Center scientist Claire Parkinson, which describes sea ice classification, observation and climate impacts. Both resources are available on one CD-ROM from NASA CORE, Item #400.0-90; they can also be downloaded for free at: **http://www.usra.edu/esse/learnmod.html.**
Recommended level: High school–adult.

Climate Change Presentation Kit (1999)

This CD-ROM is offered as a resource to help prepare talks for students or the general public. The toolkit allows teachers the option of picking and choosing the

components that they would need to communicate climate change issues to audiences. It contains fact sheets, a power point slide presentation, and interactive activities that are designed to interest audiences of all levels. Contains the essentials for brief presentations on the complicated issue of climate change. Communicates the information in a way that is easy to understand. The CD provides basic information on climate and weather and then provides straightforward answers to potentially confusing questions regarding global warming. NASA CORE Item #400.0-97.
Recommended level: Elementary–college educators.

Earth & Sky Radio—Features on NASA Earth Science

http://earthsky.worldofscience.com/

Earth & Sky (E&S) and NASA's Earth Science Enterprise have collaborated on a series of 90-second radio programs highlighting ESE science, with scientists participating from Goddard Space Flight Center and Jet Propulsion Laboratory. The E&S radio series programs are produced for a measured audience of more than 3.8 million listeners (weekly). The E&S Web site contains links to the audio and text files for all E&S shows, as well as links to related educational resources. The E&S features on NASA Earth science will also be available on CD-ROM from NASA CORE beginning spring 2000.

Earth Observatorium: Mission to Planet Earth Volumes 2

Lets you look out a porthole of the Space Shuttle Endeavour during mission STS-68 to view 12,500 images of Earth, plus many of the radar images taken during the flight. A navigation interface lets you view images by timeline, country, geographic location, or photo ID. The astronauts discuss the flight's results in a 16-minute movie. Published and copyrighted by Rocky Mountain Digital Peeks. NASA CORE Item #: 400.0-77.
Recommended level: Elementary–adult.

Geomorphology from Space (1986)

An out-of-print, NASA classic publication by Nick Short, Sr. and Robert W. Blair, Jr., is now available on CD-ROM and on the World Wide Web. This publication is designed for use by the remote-sensing science and educational communities to study landforms and landscapes. It contains a gallery of 237 color, and black and white plates of space imagery primarily of the Earth, each treating a geographic region where a particular landform theme is exemplified. Each image is paired with a detailed scientific description of the features in the image, some images are accompanied by line drawings, locator maps, geologic maps, and on-the-ground photographs of the landform. Available on CD-ROM from NASA CORE (Item # 400.0-87).
Recommended level: High school–adult.

Glacier Power (1997)

http://www.asf.alaska.edu:2222/

This CD-ROM, is a curriculum supplement module on the topic of glaciers that was developed in cooperation with NASA by the Alaska Synthetic Aperture Radar Facility (ASF) at the University of Alaska, Fairbanks and in cooperation with the Fairbanks North Star Borough School District and the University of Alaska Fairbanks, School of Education. It has been formatted to be used on the Macintosh by an Internet browser which will enable students in many rural areas who use the CD-ROM to also become acquainted with Internet functions as their schools continue progress to come online. The guide includes information on glaciers and their importance to climate studies; lesson plans; student review exercises, activities, and projects; and resources such as glacier imagery, satellite imagery, illustrations, diagrams, and more. Available online at at the Web site above or on CD-ROM from NASA CORE (Item #400.0-89).
Recommended level: Grades 4–6.

Ocean Expeditions: El Niño

http://www.teachtsp.com/products/productdetail.asp?PS=OEXNIN

Ocean Expeditions: El Niño, was developed by Planet Earth Science through support from NASA. This CD-ROM engages students in a journey where they must navigate their own ship, operate modern research tools, and manipulate satellite and climate model data to investigate and help predict El Niño—one of our planet's largest global climactic disruptions. Winner of the CODIE award in 1998 as the best secondary school software product. Distributed by Tom Snyder Productions.
Recommended level: Middle school.

The Remote Sensing Tutorial (1999)

This CD-ROM is a tutorial approach to learning about the role of space science and technology in monitoring the Earth's surface and atmosphere. As you work through the tutorial, you will come to understand how remote sensing is applied to studying the land, sea, and air making up the environments of our planet. Not only will you gain insight into past uses of aerial photography and space imagery as records of the Earth's geography as well as the future plans for more advanced monitoring systems, but you should develop skills in interpreting these visual displays and data sets both by direct inspection and by computer processing. The CD-ROM, current as of early 1999, is available from NASA CORE, Item #400.0-93. The latest version of the tutorial is available to download online from: **http://rst.gsfc.nasa.gov/.**
Recommended level: College and Remote Sensing professionals.

Spaceborne Imaging Radar: Seeing the Earth in a New Way (1995)

Contains radar images of sites around the world as seen before and during the SIR-C missions of 1994. The CD-ROM contains handheld photographs from the Space Shuttle, QuickTime movies from the missions, and photographs from the ground. Using captivating examples such as the mountain gorilla habitats of Rwanda, a radar-generated flyby of the Galapagos Islands, the discovery of the Lost City of Ubar in the Arabian desert, and many others, the CD-ROM puts our Earth at students' fingertips. Teachers may use the CD-ROM in many ways, from activities as simple as viewing pictures or as complicated as performing science experiments with real data taken from Earth orbit. Students can learn about imaging radar through the structured lesson plans or think up their own experiments and analyze radar image data from the SIR-C missions. NASA CORE Item #400.0-75.

Recommended level: Grades 5–12, undergraduate.

Visit to an Ocean Planet (1998)

Interactive, educational CD-ROM that reveals the importance of our oceans to global climate and life. Allows users to explore the Gulf of Mexico with satellite data, investigate the 1997–98 El Niño, discover "what's up" with Earth-orbiting satellites, and learn about the research activities of real life oceanographers. The curriculum background materials are arranged in the context of widely accepted teaching themes. The CD-ROM also highlights results from NASA's TOPEX/POSEIDON satellite. NASA CORE Item #400.0-92.

Recommended level: Grades 5–12.

BOOKS/BROCHURES/ NEWSLETTERS

Earth from Above: Using Color-Coded Satellite Images to Examine the Global Environment (1997)

Written by NASA Goddard Space Flight Center scientist Claire Parkinson, ***Earth from Above*** provides an easy introduction to understanding and interpreting satellite images. Beginning with two short chapters on visible satellite images and radiation, the book then covers six key Earth-atmosphere variables on such environmentally important topics as the Antarctic ozone hole, El Niño, deforestation, the missing carbon dilemma, and the effects of sea ice, snow cover, and volcanoes on atmospheric temperatures. A final chapter broadens the discussion to consider satellite Earth observations in general.

The book is heavily illustrated, including photographs, maps, schematic diagrams, and 50 color-coded satellite images. Each section concludes with a list of questions encouraging the reader to review the text and, in the case of sections with satellite image, to examine the images and find answers from them. Answers to all questions are provided at the back of the book.

Available for $38 from University Science Books, 55D Gate Five Road Sausalito, California 94965; Phone: (415) 332-5390; Fax: (415) 332-5393; Email: univscibks@igc.org.
192 p., ISBN 0-935702-41-5.
The book can also be ordered online at: **http://www.uscibooks.com/.**

Earth Science Enterprise Education Update

A free, monthly Email newsletter, which contains information on NASA Earth science education activities, research announcements, current science news, and calendar of upcoming education events. To subscribe, please send Email to: mtpe_ed_newsletter@listserv.gsfc.nasa.gov. Back issues are available at: **http://earth.nasa.gov/education/edreports/index.html.**

EOS Science Plan

http://eospso.gsfc.nasa.gov/sci_plan/chapters.html

The ***Earth Observing System (EOS) Science Plan*** is the product of leading scientists around the world who are participating in NASA's Earth science program. The purpose of the Plan is to state the concerns and problems facing Earth Science today, and to indicate contributions that will be made toward providing solutions to those problems, primarily through the use of satellite-based observations that will be obtained with EOS satellites and instruments.

Within this publication, the reader will find types and quality of data that will be produced from the satellite observations, how they will improve over existing measurements, and how the data will be applied to solving the problems described. Seven topical chapters discuss the nature of the science being reviewed: radiation, clouds, water vapor, precipitation, and atmospheric circulation; ocean circulation, productivity, and exchange with the atmosphere; greenhouse gases and atmospheric chemistry; land ecosystems and hydrology; cryospheric systems; ozone and stratospheric chemistry; and volcanoes and climate effects of aerosols.

All 7 topical chapters and the chapter summaries are provided in Adobe Acrobat Portable Document Format (PDF) and can be downloaded from: **http://eospso.gsfc.nasa.gov/sci_plan/chapters.html.**

Understanding Our Changing Planet: 1999 Earth Science Enterprise Fact Book

http://eospso.gsfc.nasa.gov/eos_homepage/misc_html/fact_toc.html

In 1991, NASA launched a comprehensive program to study the Earth as a system, now called the ***Earth Science Enterprise***. By using satellites and other tools to intensively study the Earth, we hope to expand our understanding of how natural processes affect us, and how we might be affecting them. Such studies will yield improved weather forecasts, tools for managing agriculture and forests, information for fishermen and local planners, and, eventually, the ability to predict how the climate will change in the future. This booklet provides an overview of NASA's Earth Science Enterprise.

WWW SITES: K–12 EDUCATION

The following K–12 education Web sites include teaching modules, curriculum, and education resources related to NASA's Earth Science Enterprise.

Destination Earth: the Official Web Site for NASA's Earth Science Enterprise

http://earth.nasa.gov

This site should be your starting point for learning about ***NASA's Earth Science Enterprise*** (ESE). Includes current ESE news and events, sections on education for teachers (Teaching Earth Science) and students (For Kids Only), information on current research opportunities, an Earth Science Image Gallery, and Multimedia Library. Many links to other information resources are also included.

Earth System Science Online Courses for K–12 Teachers

http://www.cet.edu/essea

K–12 Earth System Science (ESS) online graduate courses have been developed within the Center for Educational Technology (CET) at Wheeling Jesuit University for NASA's Earth Science Enterprise. The Earth system science courses use an innovative instructional design model, are delivered over the Internet, and feature student-centered, knowledge-building virtual communities. These courses are available for universities, colleges, and other science education training organizations to use. To view the courses, use "cet" as the user name and password.

Echo the Bat

http://imagers.gsfc.nasa.gov/

The ***Adventure of Echo the Bat*** is a program with both online and classroom components. The first unit, Understanding Light, provides a foundation for remote sensing and introduces the electromagnetic spectrum. The unit on Remote Sensing includes the Adventure of Echo the Bat, which is an interactive Web site allowing students to follow Echo the Bat as he migrates through Arizona. The adventure offers a directed and investigative approach to how land features look from space, what the colors mean in a Landsat image, and an introduction to identifying habitats in a false color Landsat image. Students go on to identify features in other satellite images using both images off the Web site and other textual resources. A unit follows on biodiversity covering topics such as food chains, food webs and the NatureMapping program. The site is supported with a teacher's guide that includes lesson plans, classroom activities, and reproducibles. The units can also be utilized outside the program as supplemental activities within a required curriculum. All materials are available free on the Web.
Recommended level: Grades 5–8.

Exploring the Environment

http://www.cotf.edu/ete

Online, problem-based modules developed by NASA's Classroom of the Future for K–4, 5–8, and 9–12 teachers and students. Modules address events such as volcanoes, hurricanes, dinosaur extinction theories, deforestation, endangered species, and global change. Use of NASA remote sensing images is a feature of the site—with tutorials about how to analyze Landsat images with NIH Image.
Recommended level: K–12.

From a Distance: An Introduction to Remote Sensing/GIS/GPS

http://education.ssc.nasa.gov/ltp/

This WWW site was developed and is maintained by NASA John C. Stennis Space Center. It includes lesson plans on remote sensing for grades K–3, 4–8, and 9–12 that were developed by professional educators, as well as links to related education resources.

GLOBE Program

http://globe.fsl.noaa.gov/

Students from all over the world are participating in the ***Global Learning and Observations to Benefit the Environment (GLOBE) Program*** by taking daily environmental measurements at their schools and sharing their data via the Internet. Some features on this Web site are specially designed and available only to GLOBE teachers and students who are trained in GLOBE measurement procedures. However, most features are available to anyone wanting to learn more about GLOBE, review the scientific areas of GLOBE study, and see the GLOBE student data.

GLOBE Soil Science Education Web Page

http://ltpwww.gsfc.nasa.gov/globe/index.htm

This Web page is designed to provide a resource about Soil Science for K–12 students and teachers, and to supplement the soils information in the *GLOBE* Teacher's Guide. It includes basic concepts, stories, songs, photographs, learning activities, references, links to related Web pages, and other features related to Soil Science.

JPL Imaging Radar Home Page

http://southport.jpl.nasa.gov

The goals of this site are to: inform the public about NASA and JPL's work in radar remote sensing of the Earth's surface; describe to interested users how they may obtain, use, and analyze radar data and images; provide educational outreach.

NASA's Learning Technologies Project

http://learn.ivv.nasa.gov/

Web site of *NASA's Learning Technologies Project* (LTP). The goal of this program is to promote the growth of a national information infrastructure using the vast amount of information NASA has acquired since its creation. Access to this knowledge will allow the public and industry to contribute to rapid and significant advances in science, engineering, and technology. All of the LTP projects will increase public access to scientific databases, develop new applications and pilot programs for using science data, and create new curriculum products and tools for K–12 and K–14 education—all of this via the Internet.

From this site you can link to all LTP products.

PUMAS (Practical Uses of Math and Science)

http://pumas.jpl.nasa.gov

PUMAS (poo' • mas), is the online journal of brief examples illustrating how math and science concepts are actually used in everyday life. Our goal is to capture, for the benefit of pre-college education, the flavor of the vast experience that working scientists have with interesting and practical uses of math and science.

PUMAS examples may be activities, anecdotes, descriptions of neat ideas, formal exercises, puzzles, or demonstrations, written primarily by scientists, in any style that serves the material well. They are intended mainly to help K–12 teachers enrich their presentation of science and math in the classroom.

All examples are peer-reviewed by at least one scientist with a relevant background, and at least one teacher at an appropriate grade level. Teachers can search the PUMAS collection based on curriculum topic, grade level, and subject. They can select relevant examples, and develop ideas of their own about how to integrate the material into their lesson plans.

SkyMath: Mathematics for a Blue Planet

http://www.unidata.ucar.edu/staff/blynds/Skymath.html

The University Corporation for Atmospheric Research (UCAR) received funding from the National Science Foundation to prepare *SkyMath*, a set of middle school mathematics modules incorporating weather data. SkyMath requires teachers and students to acquire and use current environmental and real-time weather data in ways that embrace the dynamic and the uncertain natures of these data, in order to promote the teaching and learning of significant mathematics, consistent with the standards set by the National Council of Teachers of Mathematics. The SkyMath modules may be freely downloaded from the Internet.

Understanding the Biosphere from the Top Down: Earth Science Teacher's Guide for Grades 4–12

http://geo.arc.nasa.gov/sge/jskiles/top-down/intro_product/title-page.html

This Web site contains a 22-lesson package written by eight local teachers working with the advice and help of Ames Research Center (ARC) personnel in Earth Sciences. The lessons focus on studying the biosphere from space to teach students about the Earth system.

Virtual Vacationland

http://www.bigelow.org/virtual/

Virtual Vacationland is a resource tool to help elementary and secondary teachers and students find and use Earth science data and information on the Internet. Content is arranged by science topic. Each topic has a preview page that summarizes the material. Each topic also has 2 to 5 detail pages, which show where to access online data and what the data mean. The site includes over 40 hands-on activities available on the following science topics, with new topics being added as the site grows: Land Topography; Ocean Bathymetry; Coastal Tides; Ocean Buoy Data; Ocean Temperature; Weather and Climate; and Watersheds and Rivers.

WWW SITES: RESEARCH, DATA, AND INFORMATION

The following WWW sites provide background information and resources that may be useful for college-level instruction, lesson plan development, student research projects, and sources of NASA research information and imagery. Many include sections on K–12 education.

Astronaut Photos of Earth

http://eol.jsc.nasa.gov

The Earth Science home page provides access to the database of the Office of Earth Science/Johnson Space Center containing records of the location and description of over 350,000 astronaut photographs of the Earth. Other features include image highlights from shuttle missions and from the Shuttle/Mir missions. Internet guests may also view Space Shuttle orbit track maps and calculate shuttle positions when specific times are entered into the program.

Destination Earth: the Official Web Site for NASA's Earth Science Enterprise

http://earth.nasa.gov

This site should be your starting point for learning about *NASA's Earth Science Enterprise* (ESE). Includes current ESE news and events, sections on education for teachers (Teaching Earth Science) and students (For Kids Only), information on current research opportunities, an Earth Science Image Gallery, and Multimedia Library. Many links to other information resources are also included.

Earth Observing System Data and Information System (EOSDIS) Distributed Active Archive Centers (DAAC)

EOSDIS is an integral part of NASA *Earth Observing System.* It is the robust distributed system that processes, archives, and manages Earth science satellite and field data, and distributes these data to a diverse global user community. Science data products (including over 700 from missions preceding EOS) are available from the *DAACs,* with each DAAC responsible for distributing data from specific disciplines. All data products are fully supported with documentation and technical user support.

Alaska SAR Facility
http://www.asf.alaska.edu
Disciplines: Sea ice, polar processor imagery, synthetic aperature radar (SAR).

Earth Resources Observation System (EROS) Data Center (EDC) Land Processes DAAC
http://edcwww.cr.usgs.gov/landdaac/landdaac.html
Disciplines: Land processes.

Goddard Space Flight Center (GSFC) DAAC
http://daac.gsfc.nasa.gov
Disciplines: Upper atmosphere, atmospheric dynamics, global biosphere, geophysics.

Langley Research Center (LARC) DAAC
http://eosweb.larc.nasa.gov
Disciplines: Radiation budget, clouds, aerosols, tropospheric chemistry. Section on education.

National Snow and Ice Data Center (NSIDC)
http://www-nsidc.colorado.edu/
Disciplines: Snow and ice, cryosphere and climate.

Physical Oceanography Distributed Active Archive Center (DAAC)
http://podaac.jpl.nasa.gov/
Disciplines: Ocean circulation and air-sea interaction.

Oak Ridge National Laboratory (ORNL) DAAC—Educators Corner
http://www-eosdis.ornl.gov/
Disciplines: Biogeochemical Dynamics.

Socio-Economic Data and Applications Center (SEDAC)
http://sedac.ciesin.org
Disciplines: Socio-economic data related to global change.

AFFILIATED DATA CENTERS

National Oceanic and Atmospheric Administration Satellite Active Archive (NOAA-SAA)
http://www.saa.noaa.gov/
Disciplines: Satellite data—atmosphere, land, oceans, Earth science, remote sensing.

Global Hydrology and Climate Center
http://www.ghcc.msfc.nasa.gov/
Disciplines: Earth's global water cycle, the distribution and variability of atmospheric water, and the impact of human activity as it relates to global and regional climate.

EOS Project Science Office

http://eospso.gsfc.nasa.gov

The *EOS Project Science Office* produces a WWW site which allows the user to discover, retrieve, and display EOS and Earth science resources, including documents and reports, calendar of events, images, slides, fact sheets, posters, CD-ROMs, etc.

Education Resources for Oceanography

http://podaac.jpl.nasa.gov/edudoc.html

Resources on oceanography and Earth Sciences, appropriate for elementary through undergraduate education.

El Niño Web Site

http://nsipp.gsfc.nasa.gov/enso

The NASA Seasonal to Interannual Prediction Project (NSIPP), which is part of the Laboratory for Hydrospheric Processes at NASA GSFC, has produced an ***El Niño Web Site***. This site includes a nine-page El Niño-Southern Oscillation (ENSO) primer, appropriate for general audiences, which presents background information, graphics, data and images, and audio, on this timely topic.

Geomorphology from Space

http://daac.gsfc.nasa.gov/DAAC_DOCS/geomorphology/GEO_HOME_PAGE.html

WWW version of an out-of-print 1986 NASA publication. This resource is a study of landforms and landscapes, including the description, classification, origin, development, and history of planetary surfaces. The core of the book is a gallery of space imagery consisting of 237 plates, each treating some geographic region where a particular landform theme is exemplified. Commentary, photographs, locator maps, and sometimes a geologic map accompany each plate.

Global Change Master Directory

http://gcmd.gsfc.nasa.gov

A comprehensive directory of Earth science and global change data sets and data centers. Includes several search options to locate data sets of interest.

JPL's El Niño Watch

http://www.jpl.nasa.gov/elnino

Presents the latest images and press releases based on observations of the El Niño phenomenon by the US/French TOPEX/POSEIDON satellite and other JPL satellites and instruments.

Landsat Images WWW Site

http://www.jsu.edu/depart/geography/nasa/index.html

Educational Web site, developed by Jacksonville State University under a NASA EPSCoR Program grant. The site includes Landsat imagery for the Southeastern United States and includes a section on image interpretation.

Learning about Climate and Weather: Some Brief Articles

http://rsd.gsfc.nasa.gov/912/geerts/cwx/notes/briefs.html

The Web site consists of over 400 articles summarizing key issues and recent findings in atmospheric sciences. The objective is to give undergraduate-level students (and those trained at that level) a more balanced and more in-depth understanding of current issues in climate. The material is hyperlinked internally and externally. Prerequisite: An introductory college course in weather and climate.

NASA Earth Observatory

http://earthobservatory.nasa.gov

Monitor regional and global changes on our planet almost as they happen as you explore with NASA scientists the causes and effects of climatic and environmental change through the use of real satellite data.

Oceanography from the Space Shuttle

http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/OCDST/shuttle_oceanography_web/oss_cover.html

A pictorial survey of oceanic phenomenon visible to the naked eye from space. Originally published in 1989 by the Naval Research Lab, it is now out of print and only available on this Web site.

Remote Sensing Core Curriculum

http://www.umbc.edu/rscc

The Remote Sensing Core Curriculum (RSCC), sponsored by the International Center for Remote Sensing Education (ICRSE), NASA, and the American Society for Photogrammetry and Remote Sensing (ASPRS) is an education program developed in cooperation with international experts and businesses to ensure an authoritative and substantive curriculum in remote sensing. The curriculum includes a series of lecture outlines, accompanied by self-contained laboratory exercises developed to support the advancing technologies of remote sensing and its integration with spatial information systems. Digital data sets from existing and planned satellite missions will enhance the understanding of advanced concepts. The RSCC design will ensure full access to data sets, operating software, and lecture materials via the RSCC home page.

Remote Sensing Tutorial

http://rst.gsfc.nasa.gov/

A tutorial approach to learning about the role of space science and technology in monitoring the Earth's surface and atmosphere. As you work through the tutorial, you will come to understand how remote sensing is applied to studying the land, sea, and air making up the environments of our planet. Not only will you gain insight into past uses of aerial photography and space imagery as records of the Earth's geography as well as the future plans for more advanced monitoring systems, but you should develop skills in interpreting these visual displays and data sets both by direct inspection and by computer processing.

SeaWiFS Project

http://seawifs.gsfc.nasa.gov/SEAWIFS.html

The ***SeaWiFS*** instrument is studying the carbon cycle by observing the world's oceans from space and measuring ocean color. This site includes descriptive information about the project, a teachers' guide, and access to SeaWiFS data and imagery.

Terra—The EOS Flagship

http://terra.nasa.gov

Terra (formerly EOS AM-1) is the flagship of the Earth Observing System, a series of spacecraft that represent the next landmark steps in NASA's leadership role to observe the Earth from the unique vantage point of space. Focused on key measurements identified by a consensus of U.S. and international scientists, Terra will enable new research into the ways that Earth's lands, oceans, air, ice, and life function as a total environmental system. This WWW site includes descriptive information about the mission, links to fact sheets on Terra research topics, and showcases state-of-the-art computer animations of the spacecraft and instruments

TOMS Ozone Home Page

http://jwocky.gsfc.nasa.gov

This page is the home for information, data, and images for all of the ***Total Ozone Mapping Spectrometer (TOMS)*** instruments. NASA's TOMS instruments provide global measurements of total column ozone on a daily basis.

Tropical Rainfall Measuring Mission

http://trmm.gsfc.nasa.gov

The Tropical Rainfall Measuring Mission (TRMM) is a joint mission between NASA and the National Space Development Agency (NASDA) of Japan designed to monitor and study tropical rainfall and the associated release of energy that helps to power the global atmospheric circulation shaping both weather and climate around the globe. This WWW site includes descriptive information about the project, educational resources, and provides access to TRMM data and imagery.

Visualization of Remote Sensing Data

http://rsd.gsfc.nasa.gov/rsd/

Visualization of Remote Sensing Data (VRSD) is a showcase for imagery created by the Laboratory for Atmospheres at NASA Goddard Space Flight Center and by other groups. The visualizations are derived from satellite data which has been color-enhanced or otherwise processed to yield high-impact renderings of hurricanes and other natural phenomena. Because of this processing, these images should be viewed more as works of art than as raw data suitable for quantitative analysis.

VRSD is an outgrowth of a past NASA program, Public Use of Remote Sensing Data. The RSD Program provided partial funding for several innovative projects which used NASA satellite data. VRSD is sponsored by the NASA Learning Technologies Project.

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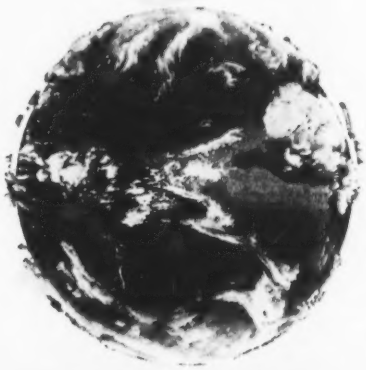
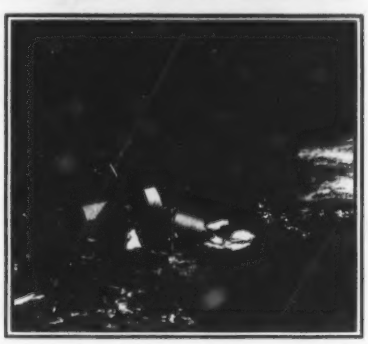
NASA Resources For Educators





NASA's Central Operation of Resources for Educators (CORE)

Established for the national and international distribution of NASA-produced educational materials in audiovisual format. Educators can obtain a catalogue and an order form by contacting:

NASA CORE
Lorain County Joint Vocational School
15181 State Route 58
Oberlin, OH 44074-9799
Phone (440) 775-1400
Fax (440) 775-1460
E-mail nasaco@leeca.org
Home Page: **http://core.nasa.gov**

Educator Resource Center Network (ERCN)

To make additional information available to the education community, the NASA Education Division has created the NASA Educator Resource Center (ERC) network. Educators may preview, copy, or receive NASA materials at these sites. Because each NASA Field Center has its own areas of expertise, no two ERCs are exactly alike. Phone calls are welcome if you are unable to visit the ERC that serves your geographic area. A list of the centers and the regions they serve includes:

AK, Northern CA, HI, ID, MT, NV, OR, UT, WA, WY

NASA Educator Resource Center
Mail Stop 253-2
NASA Ames Research Center
Moffett Field, CA 94035-1000
Phone: (650) 604-3574

IL, IN, MI, MN, OH, WI

NASA Educator Resource Center
Mail Stop 8-1
John H. Glenn Research Center
21000 Brookpark Road
Cleveland, OH 44135
Phone: (216) 433-2017

CT, DE, DC, ME, MD, MA, NH, NJ, NY, PA, RI, VT

NASA Educator Resource Laboratory
Mail Code 130.3
NASA Goddard Space Flight Center
Greenbelt, MD 20771-0001
Phone: (301) 286-8570

CO, KS, NE, NM, ND, OK, SD, TX

Space Center Houston
NASA Educator Resource Center for
NASA Johnson Space Center
1601 NASA Road One
Houston, TX 77058
Phone: (281) 244-2129

FL, GA, PR, VI

NASA Educator Resource Center
Mail Code ERC
NASA Kennedy Space Center
Kennedy Space Center, FL 32899
Phone: (321) 867-4090

KY, NC, SC, VA, WV

Virginia Air & Space Center
Educator Resource Center for
NASA Langley Research Center
600 Settlers Landing Road
Hampton, VA 23669-4033
Phone: (757) 727-0900, ext. 757

AL, AR, IA, LA, MO,TN

U.S. Space and Rocket Center
NASA Educator Resource Center for
NASA Marshall Space Flight Center
One Tranquility Base
Huntsville, AL 35758
Phone: (256) 544-5812

MS

NASA Educator Resource Center
Building 1200
NASA John C. Stennis Space Center
Stennis Space Center, MS 39529-6000
Phone: (228) 688-3338

AZ and Southern CA

NASA JPL Educator Resource Center
Village at Indian Hill
1460 East Holt Avenue, Suite 20
NASA Jet Propulsion Laboratory
Pomona, CA 91767
Phone: (909) 397-4420

NASA Educator Resource Center for
NASA Dryden Flight Research Center
45108 N. 3rd Street East
Lancaster, CA 93535
Phone: (661) 948-7347

VA and MD's Eastern Shores

NASA Educator Resource Center
Visitor Center Building J-17
GSFC/Wallops Flight Facility
Wallops Island, VA 23337
Phone: (757) 824-2298

Regional Educator Resource Centers (RERCs)

Offer more educators access to NASA educational materials. NASA has formed partnerships with universities, museums, and other educational institutions to serve as RERCs in many states. A complete list of RERCs is available through CORE, or electronically via NASA Spacelink at:
http://spacelink.nasa.gov/ercn/

NASA's Education Home Page

Serves as a cyber-gateway to information regarding educational programs and services offered by NASA for the American education community. This high-level directory of information provides specific details and points of contact for all of NASA's educational efforts, Field Center offices, and points of presence within each state. Visit this resource at the following address: **http://education.nasa.gov**

NASA Spacelink

One of NASA's electronic resources specifically developed for the educational community. Spacelink is a "virtual library" in which local files and hundreds of NASA World Wide Web links are arranged in a manner familiar to educators. Using the Spacelink search engine, educators can search this virtual library to find information regardless of its location within NASA. Special events, missions, and intriguing NASA web sites are featured in Spacelink's "Hot Topics" and "Cool Picks" areas. Spacelink may be accessed at:
http://spacelink.nasa.gov

NASA Spacelink is the official home to electronic versions of NASA's Educational Products. A complete listing of NASA Educational Products can be found at the following address:
http://spacelink.nasa.gov/products

NASA Television (NTV)

Features Space Shuttle mission coverage, live special events, interactive educational live shows, electronic field trips, aviation and space news, and historical NASA footage. Programming has a 3-hour block-Video (News) File, NASA Gallery, and Education File-beginning at noon Eastern and repeated five more times throughout the day. Live feeds preempt regularly scheduled programming.

NTV Weekday Programming Schedules (Eastern Times)

Video File	NASA Gallery	Education File
12–1 p.m.	1–2 p.m.	2–3 p.m.
3–4 p.m.	4–5 p.m.	5–6 p.m.
6–7 p.m.	7–8 p.m.	8–9 p.m.
9–10 p.m.	10–11 p.m.	11–12 p.m.

Check the Internet for programs listings at: **http://www.nasa.gov/ntv**

For more information on NTV, contact:

NASA TV
NASA Headquarters
Code P-2
Washington, DC 20546-0001
Phone: (202) 358-3572

How to Access Information on NASA's Education Program, Materials, and Services

EP-1999-06-345-HQ

This brochure serves as a guide to accessing a variety of NASA materials and services for educators. Copies are available through the ERC network, or electronically via NASA Spacelink.

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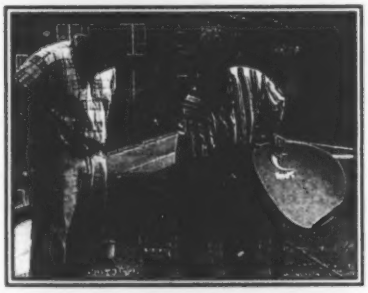

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Cover image provided by
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COVER IMAGE DESCRIPTION

TRMM rainfall superimposed on AVHRR Pathfinder July 98 monthly average.
Image produced by the Visualization Analysis Laboratory, Laboratory for Atmospheres, NASA GSFC.

The average precipitation for July 1998, based on microwave data from the Tropical Rainfall Measuring Mission (TRMM) is depicted overlaid on the Pathfinder vegetation map. Progressively higher amounts of precipitation are indicated by light blue, green, yellow, and red colors. Progressively denser vegetation is indicated by darker shades of green over land.

The prominent precipitation area along the Equator is commonly referred to as the Intertropical Convergence Zone (ITCZ). The heavy rains in Southern Asia and surrounding waters are the result of the Summer Monsoon, and the heavier amounts at higher latitudes are related to the normal tracks of mid-latitude storms. Equally important are the large areas with very little precipitation due to clear, dry weather in the subtropical high pressure regions. The major desert areas depicted in the vegetation map across northern Africa and the Middle East demonstrate that such dry conditions occur routinely. Other dry areas, such as central South America and central Africa, have significant vegetation, because they receive significant rains in many other months of the year.

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View from GOES 8: Hurricane Floyd, 9-14-99. Image provided by Barbara Summey, GSFC, and produced by the Visualization Analysis Laboratory, Laboratory for Atmospheres, NASA GSFC.
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R.B. Husar, Washington University. The Earth image is synthesized from four remotely sensed data layers: visible light reflection over land (SeaWiFS), fires over land (AVHRR), aerosol over the oceans (AVHRR), and infrared cloud image from four geostationary satellites.
EarthKAM, TERC
Model of CHEM Spacecraft and the limb of the Earth, showing both beams from the TES instrument. Image provided by Barbara Summey, GSFC, and produced by the Visualization Analysis Laboratory, Laboratory for Atmospheres, NASA GSFC.

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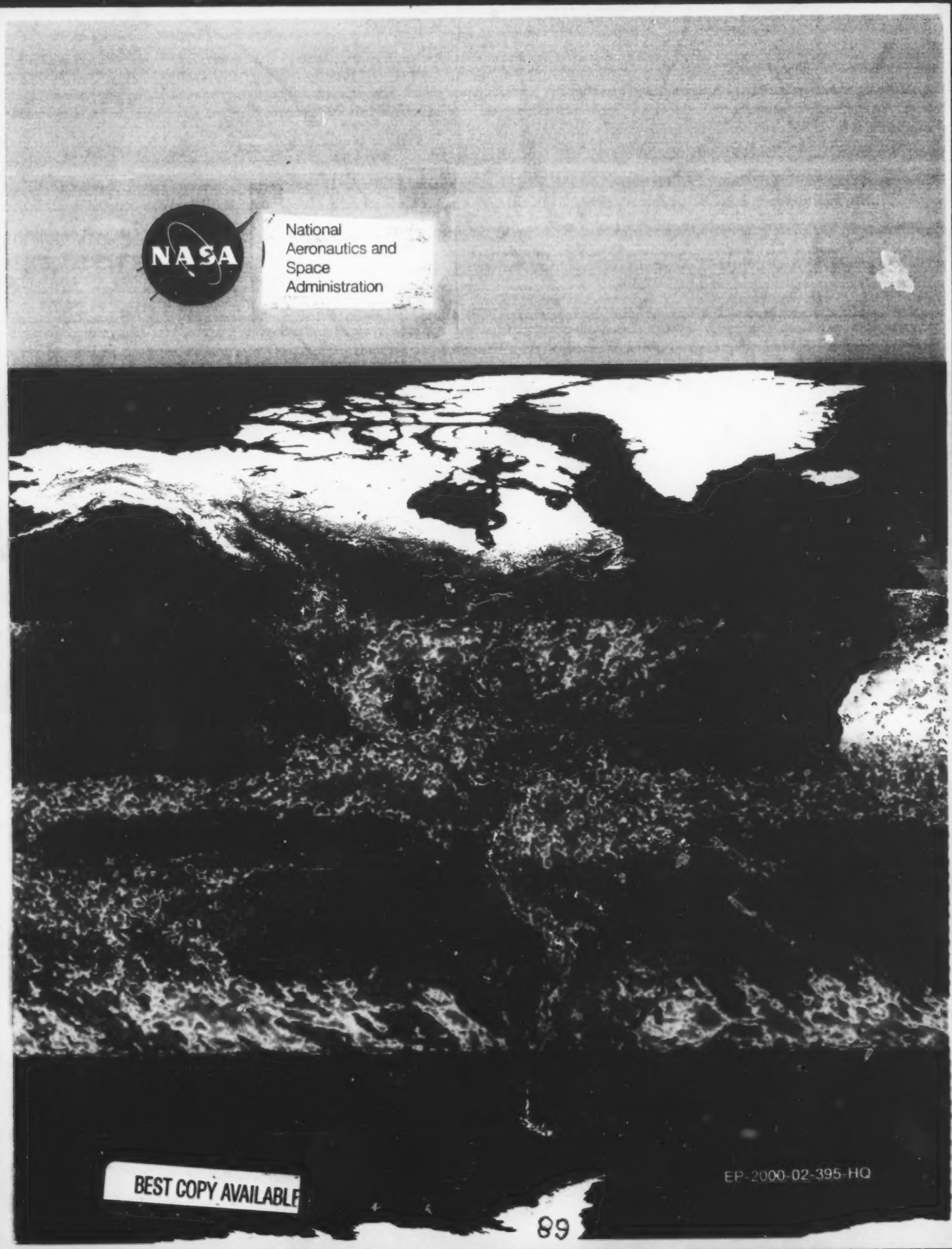

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